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THE

JOURNAL OF SCIENCE.

MARCH, 1884.

I. THE PHYSICAL AND CHEMICAL LIMITS TO POPULATION.

IN a recent work* of merit, and which derives additional importance from the auspices under which its contents were first put forward, we noticed a very strange quotation. The author gives as "very suggestive" the following extract from the "Progress and Poverty" of Mr. Henry George:—"That the earth could maintain a thousand billions of people as easily as a thousand millions is a necessary deduction from the manifest truth that, at least as far as our agency is concerned, matter is eternal and force (energy) must for ever continue to act."

It is, of course, under common circumstances, no part of our duty to discuss the utterances of politico-social "reformers" and ochlogogues. When such utterances, however, betray a misconception or a misapplication of scientific truths, we feel bound to put in our protest. Never was there a more fitting season for such a protest than at present. We are perplexed—almost pained—to find out by what process of thought Mr. George has come to regard the indestructibility of matter and the conservation of energy in the light which he manifestly does.

If both matter and energy were to come to a sudden end this day next year, or this day ten years, it is plain that up to that date the scope for animal—and in particular for human—existence would remain precisely what it is. If,

* Energy in Nature. By W. LANT CARPENTER, B.Sc.

instead of such instantaneous extinction, a very slow decrease were to set in, the possibility of life might not be appreciably lessened, say, for a century to come. So little connection has the persistence of energy with the sum total of people which this earth can support at any one time! But the *quantity* of such energy, especially in the forms of light and heat, is a matter of much greater importance in this connection. Did the earth receive a considerably larger supply of heat, Greenland, Spitzbergen, the vast Antarctic continent, and many other portions of the frigid zones now waste, might be covered with luxuriant crops. Hence it is not so much the *persistence*, as the present *quantity* of light and heat, which gives the physical limit of population.

We may go further: the invariability of the total amount of energy in the universe is not to be called in question. But that our earth will continue for ever to receive the same share of light and heat as she now does is, in the present state of knowledge, not to be supposed. The sun, which took its origin in time, must in time cool down, and cease to irradiate the planets. The planets themselves will have long ago dissipated their stock of internal heat, and will therefore either continue to roll round the extinct sun as dark, dead bodies,—the corpses of worlds,—or will, one by one, have fallen into the decaying luminary, and for a time have revived his power.

The latter case is, of course, instant destruction. The former must mean a gradual decrease of the light and heat, which even now is insufficient to maintain the whole globe in a condition fit for the maintenance of higher plant and animal life. Consequently the time must come—though it may be yet far remote, and may approach very slowly—when the lifeless and useless portions of the globe will broaden, and when death and sterility will creep from the Poles into what are now temperate regions. Surely the persistence of energy affords a shadowy basis for a faith in the possibility of a population of a thousand billions!

We come now to the second truth upon which Mr. George builds his extravagant estimate. Matter is, as far as we can perceive, indestructible. Be it so. But matter, as every school-boy is in these days supposed to know, consists of some seventy distinct kinds, not by any human agency convertible one into another. Of some of these kinds the supply is practically indefinite, whilst that of others is very limited. Now it happens that some of the elements which are employed in building up the bodies of plants and animals, and without which they cannot exist, are comparatively scarce.

One of these elements is phosphorus. Without it plants cannot grow. Without it the nervous system and the bones of animals cannot be formed. Now—borrowing an illustration from a critique in the "Chemical News"—we will suppose a planet which contains in its rocks, its soils, and its waters, a million ounces of phosphorus in different states. Suppose such planet inhabited by a race of beings, each of which, on an average, contains an ounce of phosphorus in its body. The eternity of phosphorus, and of every other form of matter notwithstanding, it is plain that a thousand millions of such beings could not co-exist upon the face of the planet in question.

It is surely, then, evident that the limit to population is given by the *quantity of certain kinds* of matter, their indestructibility being utterly unable to make one ounce play the part of two, or of a hundred or of a thousand ounces.

But we may go very much farther. We cannot live on—or, in more technical language, we cannot assimilate—the elements such as they exist in the free state, or in inorganic combinations in the air, the water, and the rocks. Our need for phosphorus has been already referred to. But if we take into our stomachs free, pure phosphorus, in its uncombined condition, the result is not nutrition, but death. Or suppose we take one of its mineral compounds, such as apatite, a phosphate of lime, or vivianite, a phosphate of iron, grind it into the finest powder, and swallow it. Will it in any way nourish us? Will it supply our bodies with the phosphorus which they need? Not in the least. It will be excreted just as it was eaten, unchanged and undigested.

Another essential component of our bodies is nitrogen. The atmosphere, we know, contains a relatively infinite supply of nitrogen in the free or elementary state. We take this nitrogen into our bodies at every breath we draw; but it is not retained and assimilated; we exhale it again unchanged precisely as we drew it in.

Just the same is the case with carbon, one of the most abundant components of our bodies. It exists in the diamond, in graphite, in anthracite in a nearly pure condition. It is found in the air, in the form of carbonic acid. But we cannot obtain the carbon we want by eating graphite or inhaling carbonic acid.

In like manner we might pass through the whole list of substances which go to build up our bodies, and show that we cannot obtain them from mineral sources. Our supply of all these substances is drawn from the consumption of vegetable and animal matters containing them in *organic*

combination. And these compounds which nourish us are not eternal or indestructible; they are very easily destroyed, and their elaboration is tedious. So far we cannot make even the simplest of them artificially. We cannot, so far, take the oxygen and hydrogen of water and the carbon of coal or chalk, or of the atmosphere, and combine them together so as to form starch, or sugar, or oil. We have to depend on the agency of plants, and to wait while they effect the task, which, in regions outside the tropics, they only carry on for about half the year. Plants, then, can extract phosphorus, and lime and sulphur, &c., from the soils; carbon, oxygen, hydrogen, and nitrogen from the air, the water, and from the remains of plants and animals which have ceased to live, and can elaborate the whole into compounds which we in turn can digest and assimilate, or, in other words, make part of ourselves. One task, however, the plant is unable to do: it cannot, as the most careful experiments show, take the free nitrogen of the air and assimilate it. It has to depend upon certain compounds of nitrogen, such as ammonia and nitric acid, which exist in the air, the water, and the soil, but to *a very limited extent*. Now these compounds of nitrogen are being formed but slowly, and they are very liable to destruction, *i.e.*, to a decomposition into free nitrogen. Whether the entire stock of combined nitrogen in the world is maintained at a constant level, or is decreasing, is a very doubtful question. It is certain that if we allow animal matter, blood, flesh, urine, &c., to putrefy, a certain proportion of the nitrogen present escapes as free nitrogen.

Whether man will ever succeed in making the nitrogen of the atmosphere available as plant-food,—and hence ultimately as human food,—by converting it into ammonia or nitric acid, time only can show. Many experimentalists have grappled with this grand problem, and ammonia, &c., have been actually produced, but so far the cost of the article obtained has exceeded its value. Hence it is, for the present, premature to take the free nitrogen of the atmosphere into account as a possible source of food.

Now why do we mention the above facts, which, to many of our readers at least, must be a thrice-told tale? Simply to remind them how very much more of the elements of food are required than what is, at any given moment, locked up in human bodies. To take a very simple illustration: a trader needs not merely capital sufficient to stock his shop; he requires funds sufficient to maintain himself, to meet all current expenses, and to buy in fresh goods until the pay-

ments for his first sales have come in. Just so here. Let us take the single case of phosphorus. Besides the quantity contained in the bodies of man and other animals, there is a reserve-capital in the soil; there is a further stock of phosphorus in the bodies of the dead and the excreta of the living which is being gradually converted into plant-food, and there is a further quantity accumulating in the tissues of plants, but not available until the crops have reached maturity. All these items form, so to speak, the world's working capital of phosphorus. Is there the remotest possibility that this capital is large enough to enable her to conduct operations a *million times* larger than those which even now appear at times to cripple her resources?

As with phosphorus so with combined nitrogen, and more or less with all the rarer constituent elements of our bodies.

We have still, however, one important consideration, *viz.*, the fact that a very large proportion both of the excreta and of the dead bodies of mankind are, so to speak, *withdrawn from circulation*. The liquid and solid excrements of the four million inhabitants of London, together with their household refuse of various kinds, are let flow into the sea. How long it may be before they can reappear in the form of plant-food—much more of human food—it is impossible to calculate.

We have thus shown that the chemical limit of possible population depends not on the "eternity" of matter, but on the supply of certain kinds of matter as existing in certain conditions, which are anything but eternal.

There is another limit easily overlooked by orators and enthusiasts. Every sanitarian knows the difficulty of obtaining, for domestic purposes, a sufficiency of pure water untainted by putrescent or putrescible animal matter, Let us imagine the population, and consequently the quantity of pollution increased *a millionfold*. How is pure water to be procured? In like manner, how are the excreta of such a fearful multitude to be disposed of? Where will be the gathering-grounds for water, the irrigation-farms, or even the precipitation-tanks, when an uninhabited acre will be a rarity?

There is a further limit to population, having its seat in the organic world. So far we have found that as man increases, and as the plants and animals which he cultivates and protects multiply, there increase also other species of plants and animals which are man's enemies, or, in more modern phraseology, his competitors. These enemies either

insist upon sharing man's food, and from their numbers and their minuteness contrive to get the first share, leaving him the residue; or they attack our food-plants in an immature state, and to a great extent prevent them from growing. These beings—from rats, mice, and sparrows, down to the *Phylloxera*, and even to the Fungi which occasion the potato-disease, the coffee-disease, the rust and smut in wheat, and to the microbia of splenic fever in cattle and sheep—are so numerous and varied that a mere catalogue would exceed the space at our disposal. Fortunately nothing of the kind is needed. Man hitherto has been very unsuccessful in waging war with these enemies. In how few countries have even the larger beasts of prey been completely stamped out! As for the smaller pests, they—as we have already hinted—"grow with man's growth and strengthen with his strength." We have—or rather had, for they have been stolen by some visitor—a couple of specimens of the Colorado beetle, captured in New Mexico some thirty years ago. In those days it was a not very common species, one, amongst other Chrysomelidæ, living on wild Solanaceæ, and not interfering with man's well-being. But as cultivation was extended, and as potato-fields came into existence near the haunts of this harmless beetle, it suddenly multiplied to an extent heretofore unknown, selected the potato as its food-plant, swept the country to the Atlantic, and destroyed untold thousands of tons of what would otherwise have been human nutriment. Such has been the career of other vermin, pests, and parasites, and such it will continue, to an increasing extent, unless man finds out new and improved means for their destruction. Here, then, we have what may be called the biological limit to population.

The war against poverty must be waged by means of invention and discovery. He who can increase the supply of plant-food, or who can form human food synthetically from its elements, does far more for the well-being of his fellows than all the orators and agitators of the day. But scientific research is less exciting to the multitude than mass-meetings, processions, and inflammatory harangues.

As for the "deductions" of Mr. Henry George, we hope that the passage which we have quoted from his work is not a fair average specimen; otherwise there is woe in store for his followers, and for the world at large in proportion as his teachings meet with acceptance.

II. VACCINATION.

By G. S. GILBBS.

IS Vaccination scientific? The late President of the Royal Society thought it involved "a scientific principle"; but if it be true, as it certainly largely is, that "Science is measurement," then our object of research should be capable of definition. The importance of clear definition is that it relieves the mind from idle speculation. But here is our initial difficulty; for the word Vaccination has become a sort of conventional term, and is applied to many things which could not have been in the mind of Jenner.

Dr. Ballard, in his Prize Essay "On Vaccination," says, in reference to infant vaccination, that "medical man and parent alike," and again, in reference to adult vaccination, "the patient and surgeon alike, should not suppose that in the act of vaccination they were engaged in the peformance of a rite, but remember seriously that the object is *the infliction of a disease.*" It might be supposed that the business of a physician, consulted by a parent as to the health of a child, would be to cure, not to inflict, disease; and equally, that the last thing a surgeon would do would be to operate in any way upon a perfectly healthy body. It is interesting to notice that, as vaccination is no part of either medicine or surgery, the author divides the objects of solicitude between the physicians and surgeons, lest he should create jealousy, and hands over the infants to the former, while the adults have to face the latter. But whatever hesitancy there may have been on this point, there is none as to the "infliction of disease." And, extraordinary as this may appear, he is supported in it by no less eminent an authority than the late Dr. Farr, who, in one of his many excellent letters to the Registrar-General, lays down some sanitary rules, and among them this:—"*Fortify the body by a mild disease,* if such is known, against a severe disease. Vaccination, or even Inoculation, if Vaccination had not been discovered, is properly practised under this rule." It may be allowed to conjecture that such a rule would never have issued from the clear intellect of Dr. Farr if the practice had not preceded it.

In our scientific research we have now advanced one step. Vaccination is the infliction of disease. We proceed to enquire what disease? There are three kinds connected

with the practice which may be distinguished, though not scientifically definable,—the disease *à la* Jenner, *à la* Ceely, and *à la* Cameron, all supposed to be prophylactic of smallpox. According to Jenner it was the disease of cowpox, and that not the eruption arising as an outward manifestation of bad health in the cow, but the effect of transmission from the diseased horse, by the accident of dirty grooms acting as milkmaids. He describes the effect of inoculating this disease upon the healthy human frame :—"Absorption takes place, and tumours appear in each axilla. The system becomes affected, the pulse is quickened; shiverings succeeded by heat, general lassitude, and pains about the loins and limbs, with vomiting, come on. The head is painful, and the patient is now and then even affected with delirium. These symptoms, varying in their degree of violence, generally continue from one day to three or four, leaving ulcerated sores about the hands, which, from the sensibility of the parts, are very troublesome, and commonly heal slowly, frequently becoming phagedenic, like those from which they sprang." A little further on in the same treatise he remarks :—"But what renders the cowpox virus so extremely singular is, that the person who has been thus affected is for ever after perfectly secure from the infection of smallpox." Vaccination of this kind is now seldom met with; but a case, a few years ago, fell under our observation in which the prediction was certainly fulfilled, for the infant succumbed in a few days, and the rarity of the occurrence was attested by the medical attendant certifying the death as from *measles*. When the gentle and reverend father meekly suggested that the measles were of an unusual kind, the reply was "Yes, they were suppressed, you see." And so was the truth at the same time, by honest ignorance.

The disease *à la* Ceely originated about fifty years after the disease *à la* Jenner. The more frequent occurrence of smallpox after operations for cowpox gave rise to the idea that the virus was enfeebled, attenuated, or diluted beyond the point of usefulness, and that it required to be renewed or somehow strengthened. This led to the development by Mr. Ceely, of Aylesbury, of the notion that the cowpox and smallpox were essentially identical, by inoculating matter taken from smallpox patients on cows, and subsequently inoculating the human frame with the product. The result was the appearance of normal vaccine vesicles. This performance was lauded in the House of Commons, by Mr. Lowe, as the most wonderful improvement in the practice of vaccination, and was by some supposed to supply a more

reasonable basis for it than it had yet had. This disease *à la* Ceely is more frequently observable than the disease *à la* Jenner, especially in those times when the atmospheric conditions are such as to favour the spread of smallpox. So frequently does smallpox make its appearance very soon after vaccination, and so frequently does this smallpox concurrent with cowpox (so called) prove fatal, that the Registrar-General was prevailed upon to lay down a rule that such deaths by smallpox as occurred within three weeks of the operation should be recorded as *unvaccinated* smallpox, while they were really the natural and scientific result of Ceelyism.

Of the precise effects of the disease *à la* Cameron it is not possible to say very much, because it is not yet sufficiently patronised; but it may be interesting to note the cause of its invention. The more or less constant recurrence of unforeseen results in the course of operations, presumably consequent upon the accession from the numerous bodies operated on of various poison germs to unite with and accompany the virus inserted, led to extended controversies, to which lack of space forbids further allusion, and eventually to the official recognition as vaccination of the practice of taking some virus from an animal which had developed sores, as a consequence of bad health and keeping this morbid virus in motion by constantly transferring it from calf to calf. This virus is said to be innocuous. But innocuous virus is a thing scarcely known to Science, and already complaints are being heard of unexpected results.

A consideration of these circumstances will lead us readily to see that definition is not very easy. When we face the small sack of poisonous matter delicately named a vaccine vesicle, which is to provide us with the means of inflicting disease, what knowledge can we have of its contents? How can we know what disease we are about to inflict by its aid? Does it contain a germ of the horse poison accidentally communicated to the cow nearly a century ago? Does it contain a germ of the smallpox virus inflicted on the cow thirty years ago? Does it contain a germ, the outcome of the cow's own internal disorder, said to be innocuous? Further, does it contain a germ the outcome of some internal disorder of the person on whom it is, or of the person or persons from whom the matter has been transmitted? Do medical art and surgical science, either or both, supply us with any answers to these questions? Whether they do or can is, however, of small importance as compared with the answer to the practical question, whether the multiplied

and renewed infliction, haphazard, of diseases, results in the reduction of smallpox? It is often asserted that no one ever pretended that vaccination would abolish smallpox. But Jenner told the House of Commons, in 1802, that he confidently expected the extension of the inoculation of the cowpox to do so, and in 1852 the Epidemiological Society, or rather the late Dr. Seaton, assured the House of Lords that "everybody was liable to smallpox unless vaccinated"—a dictum untrue both in what it asserts and what it implies. We have the means of testing the value of these predictions in our own country by the Death Register, which is sufficiently accurate for our purpose, since the year 1838. We find, then, from the Death Register for England and Wales, that between the years 1838 and 1853, while vaccination was voluntary, the annual smallpox mortality varied from 2715 to 16,268; and between the years 1854 and 1872, with vaccination largely increased under compulsion, from 1320 to 22,907. The variations in London for the same periods, respectively, were from 211 to 3817, and from 156 to 7876. We have at hand the record, for the years 1855 to 1873) of smallpox mortality in Scotland, which in point of population is something like London turned out into the country. Here we find that for the years 1855 to 1864, under voluntary vaccination, the variation was from 426 to 1741; and for the years 1865 to 1873, under compulsion, from 15 to 2448.

It seems difficult, in the face of these figures, to see value in vaccination as a prophylactic.

But we have another witness to call in the Reports of the French Academy of Medicine, which collect from the several Departments of France an account not only of the deaths by smallpox, but also of the cases occurring year by year. These Reports have been carefully examined and collated for the years 1865, 1866, and 1867, and each tells the same tale. There is no direct compulsion on this subject in France, and the greatest diversity of practice exists in the several Departments. Thus, the whole country being divided into two groups of Departments, *viz.*, those in which the proportions of vaccinations to births reach 50 per cent (averaging 77 per cent) and those in which the proportion is less (averaging 35 per cent), we find that for the former group the cases were (in proportion to 10,000 births), in 1865, 569 as compared with 222 for the latter, less vaccinated group. In 1866 the corresponding record is 400 to 130; and in 1867, 254 to 83. Here we have surely a clear evidence that the extension of vaccination does not necessitate a diminution of smallpox.

But if the vaccinated are in no better position than the unvaccinated with regard to attack, are they not better situated with regard to recovery? The answer of the French record is clear to the contrary. Taking the years and groups of Departments as above, the figures in regard of smallpox deaths to births are 52 to 17, 52 to 11, and 28 to 8. The less vaccination, the less smallpox mortality.

Yet further, the proportions of smallpox deaths to smallpox cases for the same groups and years are, in percentages, 9·1 to 7·7, 12·9 to 8·5, and 10·6 to 9·2; or for the three years taken together, 10·86 in the Departments most vaccinated to 8·46 in the Departments least vaccinated. These facts are so much opposed to the constant assertions made respecting the greater fatality of smallpox among the unvaccinated, on the authority of Hospital reports, that we must now endeavour to bring a little scientific measurement to bear on these.

To obtain our standard rule we must revert to the condition of things in the last century, in this country, when and where the smallpox was a more or less constant subject of controversy. The controversy arose in this manner:—Lady Mary Wortley Montague returned from Turkey imbued with the desire to introduce the Turkish method of inoculation of the smallpox as a means of averting an attack of the disorder when epidemically prevalent. All English physicians did not take kindly to the notion; and when her ladyship's influence at Court procured the release of six prisoners from Newgate, conditional on their submitting to the operations of Mr. Maitland, there were pretty lively passages of literary arms among the medical men who took an interest in the subject, the operator and his friends reporting a complete success, and others denying that the disease inflicted had any of the proper characteristics of smallpox. None of the six died, however, from the effects of the operation, and fashion and fashionable physicians speedily arranged themselves by the side of her ladyship. Among these was Dr. Jurin, some time Secretary of the Royal Society, who took the very obvious method of recommending the new practice by contrasting the small fatality resulting from it with the general fatality of smallpox occurring in the usual way. He was an industrious, clever, and honest partizan, and, by no small efforts, he collected from different parts of this country records of various epidemic attacks amounting altogether to 18,066 cases with 2986 deaths, being a fatality of 16·53 per cent. The conclusion that this should be accepted as the normal fatality of

natural smallpox was hotly contested by Dr. Wagstaffe, a well-known contemporary of Jurin, who declared that when he wrote the fatality of smallpox did "not exceed one in a hundred." And Isaac Massey, at the same period, Apothecary to Christ's Hospital, stated that in several years only one child ("and he a surgeon's patient before") had died of the disorder, although "hundreds had been down of it." Time operates with cooling wings; and we may fairly suppose all partizan heat dissipated when the writer of the article on Smallpox Inoculation for "Rees's Cyclopædia," published in 1779, stated that "From a general calculation it appears that, *in the hospitals* for smallpox and inoculation, 72 die out of 400 having the distemper in the natural way, and only one out of this number when inoculated." That is, in the smallpox hospitals in this country in the last century, all the patients being necessarily unvaccinated, the fatality was 18 per cent. We take this as our standard rule. Now the disorder of smallpox being always of the same general character, "changed in nothing," and hospital accommodation at present not being inferior to that of the last century, we might fairly expect the hospital fatality now to be about 18 per cent for the unvaccinated, and proportionately less in the total as the proportion of vaccinated patients increased, *if it were true* that these died at a lower rate than the others. On the basis of a death-rate for the vaccinated of (say) one-fourth of that of the unvaccinated, what would be the total fatality in a hospital where one-half of the patients were vaccinated? Answer, $11\frac{1}{4}$ per cent. On the same basis, what would be the total fatality in hospitals where three-fourths of the patients were vaccinated? Answer, $7\frac{7}{8}$ per cent. But in the Highgate Smallpox Hospital, during the sixteen years 1836 to 1851, there were 5652 patients, of whom 3094 (more than half) were classed as vaccinated, yet the fatality in the total was 19·97 per cent; and in the hospitals under the care of the Metropolitan Asylums Board, during 1870, '71, and '72, there were 14,808 patients, of whom no less than 11,174 (just over three-fourths) were classed as vaccinated, yet the fatality in the total was 18·66 per cent. That is to say, that what is proved true of the populations at large of England, Scotland, and France, is proved true also of the patients in smallpox hospitals, that the extension of vaccination has no diminishing effect upon the smallpox death-rate.

Although these hospital reports, which may be taken as typical, for almost all those published are drawn up on the same lines, reveal in this striking manner the failure of

vaccination to mitigate any more than to protect, they are constantly appealed to for proof of the value of vaccination as a life-saver from smallpox after attack, because a differential fatality is stated for the unvaccinated and the vaccinated. Thus Mr. Marson states that the unvaccinated died at the rate of 35·55 per cent, and the vaccinated at the rate of 6·76 per cent; and the Metropolitan Board state that their unvaccinated patients died at the rate of 44·80 per cent, and the vaccinated at the rate of 10·15 per cent. These figures are simply incredible for those who are acquainted with the nature and history of the disorder; for not only is there no reason—physiological, pathological, or other—for supposing that the vaccination of the vaccinated diminishes their own risk when attacked, but, *à fortiori*, no reason for supposing that the operations performed on their bodies could anyhow increase the risk of death for those who had not had any disease inflicted upon them.

It has been said that to question their accuracy implies a charge of conspiracy to deceive on the part of Smallpox Hospital doctors the world over; but a little consideration will show that they are the outcome of a somewhat indolent want of thought.

The disorder of smallpox is one of very various degrees of danger, according to the sparseness or abundance of the eruption, and the severest and most probably fatal cases are those of the kind called confluent, in which the pustules run together, and completely cover large portions, or the whole, of the body. Yet the classification is made according to the rule that evidence of vaccination consists in the visibility of marks,—a rule certainly misleading in the case of such a disorder, as is clearly pointed out by Dr. Russell, of Glasgow, who, in giving some information about Hospital Smallpox in that city, states that some (he does not say how many) patients who had been recorded on admission as unvaccinated, because of the absence or invisibility of marks, when they became convalescent showed marks of vaccination, "some of them very good." He amended his record in consequence, but yet left it erroneous,—a double-thonged whip for the Anti-Vaccinists; for the patients who died, died "unvaccinated," while those who recovered went to swell the list of "vaccinated" recoveries. An additional proof of the accuracy of this explanation is afforded by the introduction into more recent hospital reports of a column of "doubtful," or "said to be vaccinated, but having no marks"; and these classes show, as would be reasonably expected, a very high rate of fatality.

We conclude, then, that Vaccination is not scientific; that it cannot be accurately defined; that it is completely useless for its assumed purpose; that fortification of the body by disease is a mischievous myth, and that the sooner the practice is discontinued the better it will be for the health of the community.

III. THE UPRIGHT ATTITUDE OF MANKIND.

EVERYONE must have heard or have read of the supposed perfect adaptation of the human frame to bipedal locomotion and to an upright attitude, as well as of the advantages which we gain by this erect position. We are told, and with perfect truth, that in man the occipital foramen—the aperture through which the brain is connected with the spinal cord—is so placed that the head is nearly in equilibrium when he stands upright. In other Mammalia this aperture lies further back, and takes a more oblique direction, so that the head is thrown forwards, and requires to be upheld partly by muscular effort and partly by the ligamentum nuchæ, popularly known in cattle as the "pax-wax."

Again, the relative lengths of the bones of the hinder extremities in man form an obstacle to his walking on all-fours. If we keep the legs straight we may touch the ground in front of our feet with the tips of the fingers, but we cannot place the palms of the hands upon the ground and use them to support any part of our weight in walking. Not a few other points of a similar tendency have been so often enlarged upon, in works of a teleological character, that there can be no need even to specify them at present.

But till lately it has never been asked "Is man's adaptation to an upright posture perfect?" and "Is this posture attended with no drawbacks?" These questions have been raised by Dr. S. V. Clevenger in a Lecture delivered before the Chicago University Club, on April 18th, 1882, and recently published in the "American Naturalist." This Lecture, we may add, cost the speaker the chair of Comparative Anatomy and Physiology at the Chicago University!

Dr. Clevenger first discusses the position of the valves in the veins. The teleologists have long told us that the valves in the veins of the arms and legs assist in the return of blood to the heart against gravitation. But what earthly use has a man for valves in the intercostal veins which carry blood almost horizontally backwards to the azygos veins? When recumbent these valves are an actual obstacle to the free flow of the blood. The inferior thyroid veins which drop their blood into the innominate are obstructed by valves at their junction. Two pairs of valves are situate in the external jugular, and another pair in the internal jugular, but they do not prevent regurgitation of blood upwards.

An anomaly exists in the absence of valves from parts where they are most needed, such as the venæ cavæ, the spinal, iliac, hæmorrhoidal, and portal veins.

But if we place man upon all-fours these anomalies disappear, and a law is found regulating the presence or absence of valves, and, according to Dr. Clevenger, it is applicable to all quadrupeds and to the so-called Quadrumana. Veins flowing towards the back—*i.e.*, against gravitation in the all-fours posture—are fitted with valves; those flowing in other directions are without. For the few exceptions a very feasible explanation is given.

Valves in the hæmorrhoidal veins would be useless to quadrupeds; but to man, in his upright position, they would be very valuable. "To their absence in man many a life has been and will be sacrificed, to say nothing of the discomfort and distress occasioned by the engorgement known as piles, which the presence of valves in their veins would obviate."

A noticeable departure from the rule obtaining in the vascular system of Mammalia also occurs to the exposed situation of the femoral artery in man. The arteries lie deeper than the veins, or are otherwise protected, for the purpose—as a teleologist would say—of preventing serious loss of blood from superficial cuts. Translating this view into evolutionary language, it appears that only animals with deeply-placed arteries can survive and transmit their structural peculiarities to their offspring. The ordinary abrasions to which all animals are exposed, not to mention their onslaughts upon each other, would quickly kill off species with superficially-placed arteries. But when man assumed the upright posture the femoral artery, which in the quadrupedal position is placed out of reach on the inner part of the thigh, became exposed. Were not this defect greatly compensated by man's ability to protect this part in

ways not open to brutes, he, too, might have become extinct. As it is, this exposure of so large an artery is a fruitful cause of trouble and death.

We may here mention some other disadvantages of the upright position which Dr. Clevenger has omitted. Foremost comes the liability to fall due to an erect posture supported upon two feet only. Four-footed animals in their natural haunts are little liable to fall; if one foot slips, or fails to find hold, the other three are available. If a fall does occur on level ground there is very little danger to any mammal nearly approaching man in bulk and weight. Their vital parts, especially the heart and the head, are ordinarily so near the ground that to them the shock is comparatively slight. To human beings the effects of a fall on smooth, level, ground are often serious, or even deadly. We need merely call to mind the case of the illustrious physicist whom we have so recently and suddenly lost.

The upright attitude involves a further source of danger. In few parts (if any) of the body is a blow more fatal than over what is popularly called the "pit of the stomach." In the quadruped this part is little exposed either to accidental or intentional injuries. In man it is quite open to both. A blow, a kick, a fall among stones, &c., may thus easily prove fatal.

Another point is the exposure and prominence of the generative organs, which in most other animals are well protected. Leaving danger out of the question, it may be asked whether we have not here the origin of clothing? The assumption of the upright posture may have made primitive man aware of his nakedness.

Returning to the illustrations furnished by Dr. Clevenger we are reminded that another disadvantage which occurs from the upright position of man is his greater liability to inguinal hernia. In quadrupeds the main weight of the abdominal viscera is supported by the ribs, and by strong pectoral and abdominal muscles. The weakest part of the latter group of muscles is in the region of Poupart's ligament, above the groin. Inguinal hernia is rare in other Vertebrates because this weak part is relieved by the pressure of the viscera. In man the pelvis receives almost the entire load of the intestines, and hence Art is called in to compensate the deficiencies of Nature, and an immense number of trusses have to be manufactured and used. It is calculated that 20 per cent of the human family suffer in this way. Strangulated hernia frequently causes death. The liability to femoral hernia is in like manner increased by the upright position.

Now if man has always been erect from his creation,—or, if that term be disliked, from his origin,—we have evidently nothing to hope from the future in the way of an amendment of this and other defects. But if we have sprung from a quadrupedal animal, and have by degrees adopted an upright position, to which we are as yet imperfectly adapted, the muscular tissues of the abdomen will doubtless in the lapse of ages become strengthened to meet the demand made upon them, so that the liability to rupture will decrease. In like manner the other defects above enumerated may gradually be rendered less serious.

A most important point remains: the peritoneal ligaments of the uterus fully subserve suspensory functions. The anterior, posterior, and lateral ligaments are mainly concerned in preventing the gravid uterus, in quadrupeds, from pitching too far forward towards the diaphragm. The round ligaments are utterly unmeaning in the human female, but in the lower animals they serve the same purpose as the other ligaments. Prolapsus uteri, from the erect position and the absence of supports adapted to that position, is thus rendered common, destroying the health and happiness of multitudes.

As a simple deduction from mechanical laws it would readily follow that any animal or race of men which had for the longest time maintained an erect position would have straighter abdomens, wider pelvic brims with contracted pelvic outlets, and that the weight of the spinal column would force the sacrum lower down. This, generally speaking, we find to be the case. In quadrupeds the box-shaped pelvis, which admits of easy parturition, is prevalent, Where the position of the animal is such as to throw the weight of the viscera into the pelvis, the brim necessarily widens, these weighty organs sink lower, and the heads of the thigh-bones acting as fulcra permit the crest of the ilium to be carried outwards, whilst the lower part of the pelvis is at the same time contracted.

In the innominate bones of a young child the box-shape exists, whilst its prominent abdomen resembles that of the gorilla. The gibbon exhibits this iliac expansion through the sitting posture which developed his ischial callosities. Similarly iliac expansion occurs in the chimpanzee. The megatherium had wide iliacal expansions due to its semi-erect habits; but as its weight was in great part supported by the huge tail, and as the femora rested in acetabula placed far forwards, the leverage necessary to contract the lower portion of the pelvis was absent.

Prof. Weber, of Bonn, quoted in Karl Vogt's "Vorlesungen über den Menschen," distinguishes four chief forms of the pelvis in mankind,—the oval in Aryans, the round among the Red Indians, the square in the Mongols, and the wedge-shaped in the Negro. Examining this question mechanically it would seem that the longer a race had remained in an upright position the lower is the sacrum, and the greater is the tendency to approximate to the larger lateral diameter of the European female. The front to back diameter of the ape's pelvis is usually greater than the measurement from side to side. A similar condition affords the cuneiform, from which it may be inferred that the erect position in the Negro has not been maintained so long as in the Mongol, whose pelvis has assumed the quadrilateral shape owing to persistence of spinal axis weight for a greater time. This pressure has finally culminated in forcing the sacrum of the European nearer the pubes, with consequent lateral expansion and contraction of the diameter from front to back. From the marsupials to the lemurs the box-shaped pelvis remains. With the wedge-shape occasioned in the lowest human types there occurs a further remarkable phenomenon in the increased size of the fœtal head accompanying the contraction of the pelvic outlet. While the marsupial head is about one-sixth the size of the narrowest part of the bony parturient canal, the moment we pass to erect animals the greater relative increase is there seen in cranial size, with a coexisting decrease in the area of the outlet. This altered condition of things has caused the death of millions of otherwise perfectly healthy and well-formed human mothers and children. The palæontologist might tell us if some such case of ischial approximation by natural mechanical causes has not caused the probable extinction of whole genera of Vertebrates. "If we are to believe that for our original sin the pangs and labour of childbirth were increased, and if we also believe in the disproportionate contraction of the pelvic space being an efficient cause of the same difficulties of parturition, the logical inference is that man's original sin consisted in his getting upon his hind legs."

This subject is not without direct applications. Accoucheurs cause their patients to assume what is called the knee-chest position, a prone one, for the purpose of restoring the uterus to something near a natural position. Brown-Sequard recommends, in myelitis, or spinal congestion, drawing away the blood from the spine by placing the patient on his abdomen or side, with hands and feet somewhat hanging down. The liability to *spina bifida* is greatest

in the human infant, through the stress thrown on the spine. The easy parturition in the lower human races is due to the discrepancy between cranial and pelvic sizes not having been as yet reached by those races. The Sandwich Island mother has a difficult delivery only when her child is half white, and has consequently a longer head than the unmixed native strain.

At present the world goes on in its blindness, apparently satisfied that everything is all right because it exists, ignorant of the evil consequences of apparently beneficial peculiarities, vaunting man's erectness and its advantages, whilst ignoring the disadvantages.

The observation that the lower the animal the more prolific (not universally true!) would warrant the belief that the higher the animal the more difficulties encompass its propagation and development. The cranio-pelvic difficulty may perhaps settle the Malthusian question as far as the higher races of men are concerned by their extinction.

[If the facts brought forward by Dr. Clevenger cannot be controverted, they seem to prove that man must have originated by gradual development from a four-footed being. Had he been created an erect, bipedal animal, as we find him, his structure would have been not in partial, but in perfect, adaptation to the conditions of that attitude. That some of the peculiarities of his structure are better in harmony with a horizontal than a vertical position of the spinal column, is perhaps the strongest argument against the theory of direct creation and the radical *toto cœlo* distinction between man and beast that has yet been advanced. We cannot at the moment lay our hands upon any thorough and trustworthy account of the valves in the veins of the sloth: as that animal spends its life hanging, back downwards, the structure of the veins would be interesting in this connection.—Ed. J. S.]

IV. IF TRUE?

"We may depend upon it that when Science and Theology are both sufficiently awake to see a common enemy in Spiritualism, there will be lively times."—*Light.*

WHEN a new power makes its appearance in our midst all men naturally raise the question of its probable bearings upon the existing order of things. Such an inquiry is no less pertinent in the case of a new and strange philosophy than of a newly founded empire. What will it support and befriend? What will it seek to controvert and overthrow? Is it compatible or incompatible with what we know, or think we know, already? Until these questions are satisfactorily answered the world of thought feels a curiosity largely blended with unrest.

Such is the attitude of a large proportion—may we not say of the majority?—of educated persons concerning Spiritualism. This new body of beliefs is no longer ignored. It has evidently tinctured current literature. It would be a heavy task to count up the books, or the articles in magazines and newspapers, which would never have been written but for "table-turnings" and rappings which originated some thirty years ago. Such being the case we may legitimately ask, What if these things are so? Supposing—as we neither affirm nor deny—that the claims of Spiritualism are in the main well-founded, what must follow? Will it come as an addition to our present knowledge, involving, perhaps, more or less of the rectifications which every new discovery of moment brings about? or will it run counter to our fundamental principles and to our very methods of inquiry?

A difficult question may be raised at the outset: what are the claims and the tenets of Spiritualism, and who are its authorised interpreters? It has no teachers either ordained by an infallible Church or examined and "passed" by a still more infallible "Department." But we may fairly accept, as parts of its belief, assertions which we find made in its organs and not subsequently retracted or disavowed.

Its first point, the existence of "spirit" as a substantive essence distinct from matter, and not a modification of energy, need not engage our attention. This doctrine, though of course at issue with the monistic interpretation of the universe, is accepted by the majority of civilised mankind

at the present day, including, probably, the greater portion of men of Science.

But Spiritualism, further, would have us believe that when a man is dead his spirit not merely continues to exist, but remains locally among us, and is able to interfere both with living beings and with lifeless matter. Certain phenomena are said to have been produced not referrible to any known agency, nor, so far as could be detected, due to jugglery, fraud, or collusion. It is further contended that these phenomena are produced not by any agency, as yet unknown, of the same order as light, heat, electricity, or the like, but by agents, intelligent, personal, and possessing will. It is said, moreover, that "the intelligence is not that of (living) persons present, but is different from and frequently surpasses it."

Very brief reflection will suffice to convince us of the grave importance of this claim. We men of Science have hitherto recognised will and intelligence only of two kinds. Those of us who accept the theistic interpretation of the universe admit in consequence a Divine will, infinite and unchanging, and consider that the earth and the fulness thereof have been called into being and are still upheld by the action of this Will. Hence we regard it as a "constant" not merely compatible with but underlying the invariability of Nature, or the sequence of cause and effect. We may add that the Agnostic does not deny the possible existence of such a Will, though he finds no positive evidence in its favour.

Besides this Infinite Will we have been accustomed to recognise will and intelligence in animals, and especially in man. We know that such will and intelligence often, or rather constantly, interfere with the "order of Nature," and we cannot regard them, like the Divine will and intelligence, as "constants."

But we know when and where the will of man, or of other animals, is being exerted, and where it is not. We know, approximately at least, the limits of their power and the conditions under which it can be exerted. Hence neither the Divine nor the human will can interfere with our results and our theories. We have no evidence that God will alter the atomic weight or the specific gravity of any element. We know that man cannot. We have no reason to suspect that God ever caused, or is likely to cause, light issuing from a given point to decrease in any other ratio than inversely as the square of the distance. We know that man cannot. We do not find God sometimes cancelling the

force of gravitation by causing a table to rise, say, up to the ceiling of a room where it stood. We know that man can do this only by means of certain appliances, natural or artificial. Thus he must either lift the table up from below, or raise it by ropes from above, or buoy it up by attaching to it some substance lighter than common air, such, *e.g.*, as a balloon filled with hydrogen gas. It is upon this knowledge of the constancy of the Divine will, and of the limits and mode of action of human power, that our conception of an established order in the universe, of so-called laws of Nature, is founded. It is thus that we are able, in the simpler and better-known classes of phenomena at least, to predict the future,—to know what will happen under given conditions. If, still employing the theistic hypothesis, God were, from time to time and at irregular intervals, to modify the properties of matter and the action of energy, we should be intellectually confounded and put to shame. Science—and we mean here not Science as at present constituted, but any co-ordinated body of knowledge—would be simply impossible: not merely so, but the practical business of common life would be paralysed. The belief in the uniformity of Nature extends even below the human species. According to some experiments performed by Mr. Romanes a dog has exhibited something very like superstitious fear when a bone, with which he was playing, was suddenly jerked by means of a slender silk cord.

Or suppose even that a man, sitting in his chair, could by a mere effort of will move objects at the other side of the room without touching them directly or indirectly; even then we should be in a state of the utmost perplexity until we knew the precise limits of this power and the conditions under which it is exerted.

It seems now to us that if the contentions of Spiritualism are true, we are placed, for the present at least, in a position not unlike what we should occupy if the Deity were capricious, or if man could exert his activity without the ordinary appliances. We are told that there exist around us beings, ordinarily invisible, capable of interfering in the order of things, and possessing greater power than man. We neither know the limits of this power, the conditions of time, place, and circumstance under which it is exerted, nor the ends to which it may be directed.

Thus we read of persons being "murdered by malignant spirits"; we are told of burning coals taken from an ordinary fire and laid upon the head of an elderly gentleman without even singeing his hair; of a "medium" becoming

alternately taller and shorter than his ordinary stature, the change being judged of not by sight alone, but by feeling; of living persons being conveyed through the air, and passed, without injury to themselves, through walls and floors; of gas-burners ceasing to give their ordinary light without any decrease in the apparent size of the flame; of rings being passed on to the arm of a person whilst his hand remained firmly clasped on the leg of a chair; of statues weeping; of hair embedded in a plaster-cast continuing to grow, &c., &c. Now we are on principle very reluctant to use the word "impossible." But if such things may and do happen, it seems to us that we live rather in Chaos than in Cosmos. The introduction of the arbitrary into many, perhaps all, classes of phenomena, is, to the scientific mind, craving everywhere for law and order,—a most painful notion. A new, or rather a hitherto unknown, agency or force not governed by any finite, personal intelligence, might, if discovered, compel us to re-write our text-books of physics or chemistry, or perhaps of biology. But its announcement would be far from unwelcome. We should know that in its manifestations there could be no caprice. We might rationally hope in time to discover its laws, its modes of action, its limits. With an agency or "force" governed by intelligence other than that of God—postulated as unvarying—or of living, visible man, the case is very different. So many variables are introduced into every question that its solution becomes impossible.

We cannot help noticing, with gloomy forebodings, that Spiritualism has greatly changed its character and its pretensions, and is undergoing still further changes. In its outset it was to give man a demonstration of the existence of God and of spirits generally; it was to assure him of his own continuance after death, and to afford him during life the means of intercourse with kindred and friends who have departed. Now it seems bent on the rehabilitation of much which has been for a century classed as mediæval superstition, and which was supposed to be buried for ever.

It may, perhaps, not be idle to enquire what some of the alleged Spiritualistic phenomena involve? Let us take the case of the growth of hair from plaster-casts, as it has been recently discussed by several correspondents of "Light." We may admit, for argument's sake, that the phenomenon has really taken place as described,—that there has been a true growth, demonstrated, or at least demonstrable, by measurement and weighing, and that the increment has been of the same nature as that which occurs with the hair

of the living man when still rooted in the skin of his chin or scalp. We may at once admit as a well-known fact—having, however, no bearing on the case—that "the nails and hair have been known to grow after death on some corpses." We may dismiss, as simply puerile, the hypothesis of Mr. Atkinson, that oil or pomatum which had been applied to the hair of the subject to keep the plaster from adhering may have caused the growth of the hair. Surely a mere dead fragment of an animal body devoid of all the appliances for assimilation cannot take up matter from without, and grow thereby, even if such matter contained—which pomatum does not—all the necessary constituents. But if this growth was caused by spirit-agency, then these spirits have succeeded in doing what has generally been considered possible to God alone, *i.e.*, giving life to lifeless matter, and enabling it to execute vital functions, *viz.*, assimilation and growth. It is surely a serious, if not positively alarming, supposition, that there exist unseen around us beings possessing such power, and left, so far as it appears, to exert it at their own discretion! If such beings exist, may they not quite as easily have created from time to time new animals, new plants, and new disease-germs, mocking thus alike our theories of original Divine creation and of Evolution?

It would be grossly unfair if we did not here notice a passage on this subject by "C. C. M.," in "Light" for January 26th. He asks, "But are we therefore, on the other hand, to escape from our difficulties by attributing all sorts of powers and agencies to 'spirits,' just as many now well-understood phenomena were formerly so 'explained' in unscientific ages? I think this tendency among Spiritualists is greatly to be deplored, and brings them into not unreasonable discredit." Here, therefore, we are brought again face to face with our former question, What is the orthodoxy of Spiritualism?

We come to the weeping statues. That on certain changes of weather, especially on the sudden breaking up of a long frost, statues, like many other articles of stone, wood, glass, &c., are found covered with a copious dew is known to everyone, and the cause must, we should hope, be familiar to the veriest dolt who ever "went up" for an examination. But has it ever been shown, on sufficient evidence, that such moisture issues from the eyes of a statue when all the remainder of the figure is dry? Has such liquid ever been analysed and proved to be identical with the tears secreted by man? Is every possibility of trickery

disproved? If all these questions can be answered in the affirmative, have we not then the formation of an organic secretion elaborated without the secreting organ and without the material from which it is elaborated? If this work is performed by some invisible intelligence—and we can scarcely conceive it to be due to any unsuspected natural agency—we have, again, evidence of a dreadful power. But the most serious case of this class is the reputed change of stature in a living man, effected, as is intimated, not by any innate power in the person of whom this is recorded, but by the intervention of the spirits. Whoever or whatever could produce such effects must be, humanly speaking, little less than almighty. Whence could come the material for enlarging the body of a living man? Blood, muscle, nerve-tissue, bone, &c., are not to be found anywhere stored up ready for use. Their synthesis from the elements, or from simpler combinations, is something not yet dreamt of even at Munich. And were the materials ready to hand, their intercalation into the living man must be a still more difficult task. All the world's ordinary experience would show that organised matter is elaborated only in organisms, and by them slowly and gradually. We do not see that any of these three cases involves the creation of matter; but if such instances are true the organic world, at least, seems a most painful sphere of disorder and lawlessness. It will not do to reply that all these phenomena may occur in virtue of other natural laws of which we have no knowledge. It will not do to taunt us with ignoring or denying facts because of their rarity. The point is here that will (other than the One) and law are at variance. If there are finite wills which can interfere in the course of Nature without employing material agencies, Science is impossible. The hypothesis that God may carry out his plans by the agency of these spirits leads us back to the personifying epoch of human thought, to the special genii and gods of the mythologies, to the elemental spirits of the Rosicrucians, and the Archeus of Helmont. Is this universe so poor an affair that it requires a god or a demon at every wheel and valve and lever?

The only way in which Spiritualism—supposing all its claims well founded—can be reconciled with Science is by showing the exact nature and the limits of the power of these spirits, and ascertaining under what circumstances they can and do interfere. If such limits can be determined and such circumstances ascertained we shall then be able to find the value, so to speak, of the unknown quantities which

have latterly obtruded themselves into our calculations, and to re-constitute a Science. If no such limits exist, or if they are undiscoverable, we do not see how any body of exact, co-ordinated knowledge can exist.

Be it well understood that we cannot refuse to accept truth, however unwelcome. If the "reign of law" never has existed, or having existed is giving way to the "reign of the arbitrary," the sooner we awake from our pleasing dreams the better.

In a recent number of "Light" we read the following significant words :—"Spiritualism . . . comes to scientists and tells them that there are other laws than those they recognise,—puts facts before them which mystify or are ignored until Science has learnt to *accept human testimony and human consciousness* as a part of the great revelation. The scorn with which sceptics have *hitherto treated human testimony* shall be unwrung (?), and law discovered in those realms hitherto dedicated to the imagination. . . . I may be in the minority. I can calmly wait and think of Socrates and Galileo!"

Passing over other portions of this utterance we must call attention to the words which we have italicised. Science does not reject human testimony save when it is incapable of verification. Is she henceforth to be less scrupulous? Is she to accept every assertion made without scrutiny, and thus to desert the method by which she has effected so much? The very procedure taught and followed by all the reformers of Science from Roger Bacon to Galileo was to look to things rather than words, and to depend upon observation and experiment in place of hearsay. For anyone who upholds testimony and consciousness—ever self-contradictory—as means of extending knowledge, to pose in the attitude of Galileo is, to say the least, singular. As for Socrates, even if the head and front of his offending was not, as many think, a vice not to be named, he has the demerit of turning human inquiry away from things to words, and of retarding the progress of truth for more than a thousand years.

V. CIRCULATING MUSEUM FOR EDUCATIONAL PURPOSES.

By Rev. H. H. Higgins.

AT a meeting of the Liverpool School Board, held in December last, a communication was made from the Committee of the Library, Museum, and Gallery of Art, inquiring if the duplicate specimens in the Museum could be used for educational purposes in connection with the Liverpool School Board.

The scheme was cordially entertained by the Board, and subsequently a letter was received by Mr. Moore, Curator of the Public Museum, from W. Hewitt, B.Sc., Science Instructor, mentioning a number of natural-history specimens likely to prove very serviceable to teachers in giving object lessons.

My first impression was that a small series of natural-history objects might be given to each school; but this idea was relinquished, chiefly for two reasons:—

1. In case of many applications for collections being received, the specimens granted must necessarily be small and of inferior character.
2. The collections being of little value, and remaining without alterations or additions, would probably before very long become neglected and wasted.

These considerations turned my thoughts towards the establishment of a circulating museum, the practicability and utility of which form the subject of the following report:—

The peculiarity of the scheme may be said to be based upon the recognition of a capacity in the children educated in Board Schools to be interested and delighted with objects of beauty or skill with which they are unfamiliar. This capacity is shared by all ages and ranks. A crystal vase in a drawing-room at length attracts little admiration from its owner, but fills with enthusiasm a stranger guest. The failure, in schools, of series of objects which have been extensively made up and sold as collections, has arisen mainly from the large number and insignificant individuality of the specimens. In the case of a hundred children assembled in the gallery of a class-room it would be comparatively easy to rivet and

sustain their attention during a lesson on an object of fair size and striking form, combined with beauty of colour and texture, the like of which they have never seen before. A specimen of considerable excellence, say a mineral or a shell, will not only assist the teacher in firmly implanting the instruction he wishes to give on its geographical distribution, place in Nature, and economic applications, but the beautiful and uncommon thing itself, if sent amongst children to be handled with care, and felt, and looked at closely, will, I am firmly persuaded, exercise a good moral and refining influence on some of them. A piece of quartz as big as a walnut, or the shell of the *Helix aspersa* from any old garden-wall, would probably fail to serve the same purpose, not from any fault in the children or the teacher, but simply because it would not appeal to the same natural capacity for admiration, which would therefore be left unexercised.

Such are some of the considerations pointing to the establishment of a circulating museum. A method of circulation may to some extent be suggested by the kind of collection required:—

1. It should be strictly limited to a single department or group in natural history, order being the main feature in Nature.
2. It should not consist of many specimens, probably of not more than twenty. It is thought undesirable to continue the object lessons on one group for a longer period than two months, in which time fifteen or twenty specimens might be well illustrated, and application be made for another collection.
3. A central depôt would be required for the collections. If established at the Public Museum, the distribution would be arranged under the superintendence of the Curator, Mr. Moore, and the Science-teacher.
4. Receptacles, each with lock and key, would be required for the conveyance and preservation of the collections.

A beginning might be made with a few collections consisting of type specimens of very large departments in Nature:—1, vertebrate animals; 2, animals without bones; 3, plants; 4, fossils: 5, minerals. These groups include everything suitable for an object lesson, and must therefore always remain as the fundamental groups. But it may practically be found more convenient to start with a further division of some of them. Thus, from the vertebrated animals might be segregated a group of such as suckle their

young (*Mammalia*). The enormous series of boneless animals might form two groups, animals with jointed limbs (*Arthropoda*) being set apart from the rest. Metals and metallic ores might be divided from other minerals. A supplementary series might be added for advanced classes, consisting of such groups as anthropology, with its divisions ethnology and archæology. The teacher might be left to exercise his own discretion in giving a lesson from two or even more objects at a time,—points of difference or resemblance constituting almost the entire sum of our knowledge, —but the apt teacher will be careful to preserve as long as possible some unseen treat in store.

Where the teaching on the groups has been efficient, the sight of larger collections will be found indispensable. The Liverpool Museum is free to all during four days in the week; but to ensure the largest amount of advantage to classes from schools the visiting party, under the supervision of the teacher, should not consist of more than twenty scholars. The visit should be made, if possible, at a stated hour known to the Curator, but by no means on a closed day—Tuesday or Friday. The visit should be made not for the purpose of passing rapidly through the rooms, but to a particular part,—to some special table case, or, at the utmost, to two contiguous table cases; to the wall cases in some room, or half a room; or to some 20 or 25 feet of the cases in the gallery, the teacher and his class to remain in the selected department during the whole of their visit. If the visit be made under such conditions the officials of the Museum will be instructed to put up barricades to prevent the interruption of the teacher and his class by ordinary visitors. The teacher and his pupils will, in fact, have the selected department to themselves for any time not exceeding one hour. I may be permitted to urge that such visits, together with the necessary times for going and returning, should in every respect reckon as attendance in school.

The specimens recommended for object lessons are not costly rarities, but each should be good and perfect of its kind; 6 or 8 inches in length, where such a size is ordinary; not exceedingly fragile, yet all the better if requiring respect and care in being handled by the children. Such objects as the *Arthropoda*, bees, locusts, king-crabs, a stuffed bird, or the skeleton of a small vertebrate animal, &c., might be given for examination to the class, each enclosed in a glass-capped box. Teachers and children should be encouraged to bring to the object lesson specimens of their own for comparison with the type specimens, care being taken

to avoid the introduction of objects foreign to the group.

In conclusion, I am constrained to remark that the benefit of the whole scheme must rest upon the cheerful co-operation of the teachers, and that the circulating museum is commenced quite as hopefully in behalf of the teachers as in behalf of the children. The field is one which is likely to contribute something to cheer the hours and brighten the lives of all who are engaged in giving instruction. I do not affirm that the children are already taught too much; but with a confidence, which has never swerved, in the wisdom of my old master Pestalozzi, I suggest to School Boards, high and low, that the teaching is out of all proportion in excess of the training, the latter being with difficulty weighed in the scales of school examinations. The object of the circulating museum is not so much teaching as training; not so much the inculcation of facts as the illustration of the happiness to be obtained through habits of observation.

There is a time coming when the unity of Nature, of which Evolution is but one imperfect aspect, shall be assimilated by all cultivated minds; but at present Science is driving enthusiastic love of Nature out of the field. Private collections are failing in Liverpool and all around; and teaching is hard, and hardening in its results, except in a school of extravagant fancy, in which sober average people cannot take their degrees.

Such is the state of things in which Sir James Paget, only the other day, asserted the curative properties of "Recreation by Wonder," healthy spontaneous admiration, not waiting to learn the name of the artist before venturing to praise the picture, but free as the breaking of the woods into song in the dawn of a spring morning. Scarcity of original research, forsooth? Are there not in Nature countless fields for research, original enough for the millions that never have a chance to be recreated in them, whether they be the teachers or the taught, and reminding us of the promised harvest, when both he that soweth and he that reapeth, the teacher and the scholar, shall rejoice together.

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

[(Continued from page 92.)

It was stated in the last article that unless the Science Section of the Department of Science and Art was thoroughly reformed it would strangle real scientific education in the future, as it had done in the past. That it has done so in the past has, I think, been made apparent in former articles; that it must continue to do so as long as the teacher's payment depends solely on the marks won by his pupils in the examinations is evident; for such a system of payment leaves the teacher no option,—he must *cram* his students to have a chance of earning a living. Yet every efficient teacher knows too well, as the Rector of Lincoln College, Oxford, has stated, "that this process—preparing pupils for examinations—is incompatible with genuine instruction in Letters and Science." The same high authority has also stated that the examination system was destroying education; and let it not be forgotten, in connection with this expression, that of all the examination systems at present in vogue in the United Kingdom, the Department's system is the very worst, for the teacher's payment depends solely on his pupils obtaining a certain number of marks each at the examination; if they do not obtain that number the teacher receives *no pay* for teaching them. Mr. Justice Fry, in an Address at the Salt School, Shipley, said "Knowledge is divine, but cram is a demon."

The Examiners under the City and Guilds of London Institute complain in their Reports that competent teachers are not to be met with; "this want therefore prevents the formation of technical classes in many places where such classes are greatly needed." It is evident from this that the Department's system has failed to furnish competent teachers for the courses of technical instruction promoted by the City Guilds. The Department's own examiners complain, as we have shown in former articles, of the *quality* of the teaching given in the Department's own Science Schools. Our manufacturers, and others interested in the cultivation and diffusion of sound Scientific and Technical Education, are also not satisfied with the results which have been obtained by the Department's system after its nearly

thirty years of operative existence; hence the constant demand for information, by means of Commissions and Reports, as to what is being accomplished on the Continent in these branches of instruction. In short, it is universally admitted that we are far behind continental countries in Scientific and Technical Education, and this after all the vast sums of public money that have year after year—for nearly thirty years—been placed in the hands of the permanent officials of the Department, to obtain results at least equal to those obtained in Germany and other countries, and which are obtained at a less cost than the inferior results obtained by the Department.

The question naturally arises in the mind, What is the cause of this lamentable educational failure? It is due to the system—payment on results—which our officials have forced on the country, and by the adoption of which we stand absolutely alone in the realm of education amongst all the civilised and semi-civilised nations of the earth, with the exception perhaps of China. Not alone is the system not adopted; it is condemned by other nations by the system—the very opposite of it—they follow. It is also condemned by every one in our own country who has the least pretension to be classed as an educationist; yet we as a nation continue this worthless and vicious system, whilst at the same time we are continually sending out Commissioners to report, and also publishing from other sources reports on the methods and results of the teaching in foreign countries. Why is such an unwise—one might almost add unpatriotic—course followed by our Statesmen and Senators when they find, as find they must if they give the subject any attention, that the *sole reason* why we are behind continental nations is that they adopt an enlightened system of education, whilst we adopt a worthless and vicious one. But whilst being a worse than worthless system, as an educational one, it is a most perfect and efficient one for bringing into and keeping in existence a very costly Bureaucratic Department; and most probably that explains why Parliament has never seen fit, or perhaps not been able, to reform it.

What would have been the condition of education in England if, from the days of King Alfred down to the end of Queen Elizabeth's reign, there had been established the payment on result system in place of the 245 public schools which were founded during that period, and military men had been made the Councillors-in-Chief to the Sovereign and the Ministers of the day who had charge of the education of the people. If that had occurred there would be no

Eton, Harrow, or any other of the great public schools at the present day for our aristocracy and the wealthier class to send their sons to, to be educated; all real education would have been crushed out of the land, and, as far as our ministers of education were concerned, we should be pretty much in the condition that China is at the present time. But the Rulers in England in those days were wiser as regards education than our Rulers appear to be at present; they, like the Rulers of other countries, sought out men distinguished as educationists, in our own and other countries, to advise and aid them in educational systems and projects, just as is done at the present day in Germany; for in that land of learning the custom is to associate, with the Minister of Public Instruction, men, as Councillors, who have had *large experience* in educational matters, and have given *evidence* of their administrative powers in that department. As examples of what was done in former times in securing the assistance of those renowned in the science and art of education, it may be mentioned that Alcuin, a Yorkshireman, was employed to organise the schools of Charlemagne. Sturm, who was called the schoolmaster of Germany, had a pension from the King of Denmark, another from the King of France, and a third from the Queen of England, for his educational labours, and his school-books were adopted by Ascham in England and by Buchanan in Scotland. That great and distinguished educationist of the day, John Amos Comenius, was summoned to England in 1641, by ORDER OF PARLIAMENT, to advise them on educational matters, and he would most probably have been appointed to some College to carry out his system of education, which had an important effect on Milton, but his visit to England was cut short by troubles arising in Ireland. His first great book on Education, the "Ianua Linguarum Reserata," or "Gate of Tongues Unlocked," immediately on its publication circulated throughout Europe; it was subsequently translated not only into Greek, Bohemian, Polish, Swedish, Belgian, English, French, Spanish, Italian, Hungarian, but also into Turkish, Arabic, Persian, and even Mongolic. In those days our Government, like other civilised Governments, sought for the best systems of education, for sound education was valued, and the educator was honoured and respected. The same cannot be said at the present day under the system of payment on results; the educator is not respected, he is treated as a menial, and his position is such that he can be deprived of his employment at a moment's notice by an irresponsible official by the mere stroke of his pen.

The necessity for our having a good system of Scientific and Technical Education is becoming more urgent every year; the commercial monopoly we possessed is departing from us; and if we do not adopt, and that speedily, a good system of Scientific Education, so as to provide our manufacturers and their managers with the knowledge and skill necessary for *progress* in scientific industry, other nations will outstrip us in the race. Germany, by reason of the excellent scientific education she provides for her sons, has taken the lead in the new industry—the manufacture of artificial dyes. Yet the raw products required for their manufacture are exported from England, and manufactured in Germany, and the manufactured article imported for use into England. It is estimated that the consumption in England of alizarin and the coal-tar dyes cannot be less in value than £1,000,000 per annum, and these are manufactured very largely, in fact principally, in Germany.

America, with her vast and varied natural resources, will become England's most dangerous competitor; she possesses in addition to all the raw materials we possess several others. The result is that, whilst the United States in 1880 produced 95 per cent of all the raw materials consumed in their factories, we imported 93 per cent of all that was consumed in ours.

There are likewise flocking to that country some of the most skilled workmen from the different European countries, taking with them a Technical Education and Skill in many different industries. Then, again, America and England commenced at opposite poles in manufacturing industry; they were deficient in human labour, we had an excess: hence the greater development of automatic machinery in the one country than in the other. The want of sufficient capital, which has hitherto held in check their industrial enterprise, is being rapidly supplied. It is estimated by American statists that the annual savings of the people amount to about 200 millions sterling.

In addition to the good school system they have established, they have likewise excellent colleges, where the students receive a good scientific education; and many of the students, after having finished their college course in their own educational institutions, take advantage of some of the German ones; or they visit the different European countries to see for themselves how various industries are carried on in the old world, before they commence as owners or managers of industrial factories in their own.

We need not again refer to our dependence on France for

designs for the calico-printing and other trades, as that subject was very fully dwelt upon in the article in the April number (vol. iv.)

Persons like myself, who have had practical experience in manufacturing industries and in teaching science, may point out in publications the grave defects in the Department's system; the public press may lend its aid; but in the end it rests with our statesmen either to reform this most expensive and worthless system, or allow it to continue. I took the liberty of directing the attention of some of our statesmen and senators to the subject a short time ago. From the communications I received from them, it would appear that many of them are not in favour of the system, but they do not see their way to substitute a more perfect one, which would enable Parliament to have at the same time such a complete, as they seem to think, control over the Expenditure. That control I look upon as purely imaginary. Certainly Sir Wm. Dunbar does not appear to think, if we are to judge from his remarks in some of his reports, that anyone has very much control over the permanent officials in its expenditure. I think if anyone devotes a little attention to the subject, he will come to the conclusion that it is unwise, even unconstitutional, to place such large sums of public money in the hands of officials, which, to a large extent, is based on probabilities, for the estimates are prepared in November, and the examinations, on which the result payment depends, are not held until the following May. It also tends, by having this large sum of money at their disposal, to make these officials tyrannical in their conduct to the teachers, and thus causes good men to leave the service, and prevents others from entering: cases like that about the employment of the "Darmstadt models" in teaching mechanical drawing might be cited as examples. But surely if the statesmen of other countries can establish good systems of education, and exercise at the same time full control over the expenditure, our statesmen ought to be equal to a like task; but then other countries do not put men in office who are *inexperienced* in educational matters, and who have given *no evidence* of their administrative powers in that department. To show that the control is to a great extent, if not altogether, a myth, it might be asked, were not the permanent officials uncontrolled in the expenditure of the £115,000 in connection with the Paris Exhibition of 1867? and where was the control when an accountant some years ago could abscond with public money to the extent of £7704 17s. 10d., which has never been recovered.

In place of the present system I would divide the United Kingdom into what might very properly be termed collegiate districts, and I would assign the *Inspection* and *Examination* of the Science Schools to the Professors of the College situated in each of the collegiate districts. We will first investigate the educational advantages this system would have over the present one, and afterwards compare the cost of the two, including the payment of the teachers.

By my plan not only would *Inspection* and *Examination* be combined, which is not the case at present, but the Inspection would be conducted by those who were engaged in the work of Education; whereas the Inspection is conducted under the present system by those who are not practically engaged in Education: it is mainly done by Officers in the Army. By the system proposed the examinations could be *entirely*, if desired, of a practical character, and the pupils would be examined of course as to "how they were taught, as well as what they were taught." It would prevent teachers from teaching any of the sciences of which they themselves had no experimental knowledge; in other words, it would banish mere book teaching, which prevails under the present system. Under the new system each of the pupils would be *separately superintended* and *instructed*, because each mind is different, and has different capacities, and the difficulties of understanding and coming to a knowledge of any subject vary with each individual mind. Individual instruction being adopted, the teacher would be able to teach students in different stages of advancement at the same time, as is done every day in chemical laboratories. There would be, under the system proposed, a plan and unity in the instruction given in the schools, which is entirely wanting, as has been shown, in former articles, under the present system, owing in a great measure to the plan of paying the teachers.

As the teachers would generally have less experience and extended knowledge of their subjects than the College Professors, great advantages would necessarily accrue from their coming into educational contact with the Professors. They would be able to apply to those more conversant with the subject of instruction in their difficulties; for suggestions as to improvements of the working processes; and the College Examiners would see with their own eyes, which is not as we have seen the case under the present system, whether the work of practical instruction was efficiently carried on. The colleges and schools would in many ways beneficially act on one another, and meritorious teachers in

the schools would certainly be recognised and stimulated in their work and advanced to higher positions; whereas under the present system they are left in a hopeless state of stagnation.

Another very important educational advantage which the proposed system would have over the Department's one, is that there would be diversity in the examinations. We should not then be casting all the young intellects in the science schools into the same mould, as is done at present by employing the same set of Examiners always, and for the whole of the Science Schools in the United Kingdom. Moreover, the teacher would be able to throw into his teaching more individuality and intelligence, and by diversity in the examinations we should not be pulling all these young science students "through holes of the same size, after the fashion of manufacturing wires." We are at the present time stamping these young intellects, as the Government does its sovereigns, with one uniform die, which is opposed to all sound educational principles, and obstructs progress in the Science and Art of Education.

In addition to the Collegiate Examiners the plan I propose includes a special Minister of Education and Councillors to advise him on educational matters; the Councillors would be men who had made themselves distinguished in the educational and scientific worlds; they would not be required to give their whole time to this duty; but the question about the Minister and Councillors will be more fully discussed in a future article.

Some of my readers will no doubt say that this scheme, if carried out, would cost the country some money. Certainly; and therefore I will give a few items from the estimates for the present financial year, which ends on the 31st of March, to enlighten those of my readers as to the cost of the present system:—

	1883-84.
Director of Science and Assistant-Secretary...	£1,200
Assistant-Director of Science	778
(This salary goes up to £850.)	
Official Examiner	400
Duty pay for Official Examiner	200
Assistant-Examiner	267
(The salary of this official goes up to £400.)	
Duty pay for Assistant-Examiner	100

The Official and Assistant-Examiner, whose duties I cannot make out, receive in addition to these sums from £1 1s.

to £17 17*s.*, according to the number of evenings they are employed *assisting* at examinations.

Organising Teacher in Science, at £1 1*s.* per diem, or £2 2*s.* when delivering a Lecture...	£350

The following belong to the Art as well as the Science Division :—

PROFESSIONAL EXAMINERS, paid by day and *for piecework*	£10,400
Inspectors of Schools	1,865
Occasional Inspectors at £2 2*s.* and £3 3*s.* per diem, and *Acting* Inspectors at £1 1*s.* per diem, and one Inspector who is also Lecturer in the Normal Science School at £750 a year	4,800
Lecturers paid by the Lecture, and grants in aid of the Instruction of Science Teachers at Provincial Colleges	500
TRAVELLING :—	
For General Administration, Schools of Science and Art, Circulation, Exhibitions, and Collections of Local Schools, and South Kensington, Bethnal Green, and India Museum	6,420
Temporary Clerks, Copyists, &c.	8,700

We will add one or more items in the Science division :—

Payment on Results Science Schools... ...	£49,500
Payments to Local Secretaries and Assistants	1,500
Payments to *Special* Local Secretaries and Assistants...	1,800
Science grants and prizes	4,600

To give an entire list of the multifarious items would, I am afraid, make it unreadable to most people; but I think I have given sufficient to show that this worse than worthless system costs the country yearly a very large sum of money. If the system I propose was adopted, the items I have given, and many others, would be abolished, and the money that would be expended would be expended in a healthy manner. The teachers would be paid by capitation fees, and they would be encouraged to look to the fees of their pupils as a part of their salary; and good and efficient teachers would secure paying pupils if they were under a

system that allowed them to teach in the way they considered best; but as long as they can display no independence of thought in teaching, as is the case under the present system, but are obliged to walk and make their pupils walk in the paths of Science the Examiner lays down, pupils will not pay for the instruction.

The cost of the efficient inspection and examination I propose, the travelling expenses of the Examiners, the capitation fees of the Teachers, would not amount to the sum it costs at present for the *Permanent*, the *Occasional*, the *Acting* Inspectors, the Director and Assistant-Director of Science, the *Official* and *Professional* Examiners, the travelling expenses, and the sum paid for payment on results. And by employing Councillors to advise and aid the Minister of Education, an ordinary Secretary with a small staff of Clerks would only be required at South Kensington; hence another large saving, and to this would be added a large saving on stationery and printing.

It has been announced in the public press that the Evidence and Report the Technical Comissioners are about to issue will occupy five volumes: these may be issued, but if the present system remains unreformed they will be of no permanent benefit to the country. HOW AND WHERE WE FAIL is obvious to those who have given time and attention to the subject. It is at all events my object in writing these Articles to point out the cause of our failure.

(To be continued.)

ANALYSES OF BOOKS.

An Examination and Popular Exposition of the Hylo-Idealistic Philosophy. By W. Bell McTaggart (late Captain 14th Hussars). London: W. Stewart and Co.

We have here a small but exceedingly important work. The author undertakes to furnish a clear and summary exposition of the system of philosophy thought out by Dr. R. Lewins, and known as Hylo-Idealism. So far this system has not by any means received the attention to which it is fairly entitled. Time and place are unpropitious. The modern every-day mind—may we venture to say especially the normal English mind?—cares little about philosophies. Whether the phenomena which it recognises are merely sensation of its own, whether they have an underlying objective existence, whether such phenomena are faithful copies of noumena, if such exist, it cares little. The man of special science, like the man of business and the man of pleasure, is content, for the most part, to occupy himself with the phenomena, inquiring no further. Moreover, the religious world pays itself the doubtful compliment of avoiding and denouncing all such trains of thought as possibly "leading to infidelity."

The claim put forward on behalf of Dr. Lewins is, that he has originated "a complete and self-contained system of philosophy, sufficient in itself for all things, not alone as bringing about a reconciliation of that dualism of mind and matter which has been the stumbling-block to thinkers of all generations, but as giving a sufficient answer to the problems of the universe, and furnishing a rule and guide for life."

Claims no less high, the author admits, have been put forward on behalf of other systems which have, each in turn, been found wanting. He declares that "the persistent effort to abolish the antagonism between mind and matter, subject and object, ego and non-ego, and to unite the contending theses of Materialism and Idealism into one harmonious whole," is the distinguishing feature of the philosophic work of the present day. He holds also that Dr. Lewins is working on parallel lines with Mr. Herbert Spencer, whose Transfigured Realism is practically identical, up to a certain point, with Hylo-Idealism. Perhaps it would have been well if Mr. McTaggart had distinctly shown at what point the divergence between these two great thinkers begins,

and in what it consists. He says, indeed (p. 9), concerning the dogma of animal and human automatism:—"This conclusion, from which so many Materialists have shrunk, was boldly accepted by the late Professor Clifford, and I am compelled to confess that, on the lines of Transfigured Realism, I can see no other outcome." Mr. Spencer, indeed, has disavowed the doctrine of human automatism, and has promised to show in a future work how that issue is to be avoided. He says, however, as quoted in the work before us, "Crude Realism holds that space and time are objective realities, forms of things, known *à posteriori*. Transfigured Realism holds that space and time are forms of things which have become forms of thought through organised and inherited experience of things." According to Mr. McTaggart "Hylo-Idealism teaches that space and time are 'thinks,' sense-objects, arising from stimulus *plus* response to stimulus; and are therefore, *for us*, as much objects as tables, trees, or men." These considerations will, we trust, enable the candid—though perhaps not the captious—reader to seize the difference between Mr. Spencer and Dr. Lewins.

Dr. Lewins lays down as one of his fundamental propositions that "man is the measure of the universe *for man*," the two words which we italicise being a necessary corrective addition to the original formula of Protagoras. The fundamental, and by no means dissimilar, assumption of Transfigured Realism is that "all our knowledge is based upon and bounded by experience, and that outside or beyond himself man cannot go," with the saving clause that the term experience means not alone the experience of the individual, but the collective experience of the race, which supplies the so-called "necessary truths" of Kant and his followers.

We must now glance at the two conflicting systems which Dr. Lewins undertakes to reconcile. Materialism is here defined as that philosophy which constructs the universe in its widest sense, thought and emotion included, out of matter only. For spirit it consequently finds no room. It tells us that in the brain and out of it there is nothing but energy and matter. Hence "man being in every bodily tissue, in every desire, thought, and action, only the resultant of all the conditions of his environment animal automatism,—human automatism must result. Here, then, reasoning logically upon accepted facts, we come to a conclusion which the author holds to be subversive of all morality.

Unless then we would fall into Scepticism (using the word in its philosophic sense, and not as is done at the tea-tables), and believe that the truth is non-existent or undiscoverable, we turn to the Idealists. They tell us that "There is but one existence, mind. Analyse the concept matter, and you will discern that it is nothing but a synthesis of qualities (*Materie ist Eigenschaft*)—these qualities are sensations, and the synthesis is mental." But to what does this ultimately lead us? To abso-

lute egoism,—the assumption that all things are subjective within ourselves. "If nothing exists except my thoughts, then no other mind can exist beyond my thought of it. The ground we have for believing in the existence of other minds is not a whit stronger than the ground for believing in the existence of other bodies." Here, therefore, morality is again subverted.

How then are we to accept the evident element of truth in each of the two contending systems, and yet bid farewell to each in turn when it would lead us into the quagmire? The union between Idealism and Materialism is effected by our recognising "the relativity of the two: without subjectivity no objectivity; without objectivity no subjectivity. It is by the relation between them both that both exist." Elsewhere our author writes:—"The union consists in the recognition that subjectivity and objectivity are, as it were, reverses of the same medal; that subjectivity arises only from combinations and qualities of what must be regarded as the objective, namely matter; and that objectivity, in its turn, arises also from the combinations and qualities of matter which have produced a subjective organisation capable of perceiving and responding to the objective. Matter, matter, everywhere; but let me point out,—avoiding the difficulty of the crude Materialistic hypothesis, which denies the subjectivity of Matter,—Hylo-Idealism admits that the subjective does exist, but shows that it exists as a phase of, but not independently of, matter. This is the point, both of union and of divergence, between Hylo-Idealism and Materialism." On the other hand, turning to the side of agreement with pure Idealism, we find that in the sight of the Hylo-Idealist "the whole universe of things and thoughts is only an automorphosis, each ego being to itself, as Protagoras postulated the measure and standard of all existing things, of all thought and objects of thought whatsoever."

For the solution of the old difficulty of necessity and free will, as given in the words of Dr. Lewins, we must refer our readers to the work itself. Nor can we summarise, much less discuss, the train of reasoning in which Mr. McTaggart—referring to the possibility of space of four, five, six, and even *n* dimensions—contends that a point of contact between spirit and matter seems "more than probable." But we must call attention to the author's peroration:—"Matter is affected by spirit, spirit by matter. Their union is the 'think' of the Absolute. The material universe is this 'think,' and it has become a reality to the Absolute, just as much as space and time, trees and men are our 'thinks,' and have become realities to us. Beyond this we cannot go. What is matter, or what is spirit, we cannot know; and what their point of contact is we may not even imagine. The outcome of the universe, then, which is object to us, is the 'think' of the Absolute, not the Absolute itself. Under this luminous conception crude Materialism vanishes away like an

evil dream, for matter depends on spirit. Pure Idealism must bow its head, for spirit depends on matter."

In bespeaking the attention of our readers for this book, we admit that it cannot be hastily swallowed and despatched. Though extending to 84 pages only, it will require careful, deliberate reading. But we believe that every thoughtful man, even if he does not feel prepared, at the moment, to accept the system here set forth, will derive benefit from its study. The second and third appendix, the latter bearing the ominous title "Hylo-Idealism at the British Association," will prove wholesome reading for not a few of our scientific specialists, reminding them how sandy is the foundation upon which their hypotheses are built. We have always experienced a profound sadness when we reflect how little of our recognised Science is demonstrated, or even demonstrable. An emphatic reminder on this head will be salutary to many.

We dare not venture to say that Dr. Lewins will be promptly appreciated. Official science will have none of him. Independent thinkers are few, and relatively less powerful than was formerly the case. But in the future it will be held that if the mystery of the universe can be unlocked at all, he has supplied the key.

Original Essays. By S. Tolver Preston. London: Williams and Norgate.

The Essays herein contained discuss the social relations of the sexes, science and sectarian religion, the scientific basis of personal responsibility, and evolution in reference to female education. All these topics are discussed in the light, or at least in the spirit of the Evolutionist School.

A contemporary has recently taken occasion to regret what it styles the common "misapplication and abuse" of the principle of Evolution, "especially its application in the most illegitimate and unscientific way to the solution of questions in the domain of morals and religion, which lie completely beyond its province." This regret we by no means share. On the contrary, we hold that the principle of Evolution has been succcessfully applied to social and moral questions, among others by Mr. Tolver Preston, and has already led to valuable results which would not otherwise have been attainable."

The first of the essays before us deals with a question which has been systematically ignored. Says our author, very truthfully, "A thoughtful consideration of the whole subject may, perhaps, warrant the conclusion that man has advanced *less* in

knowledge as to the proper mode of viewing the true principles that should regulate the ethical feelings existing between the sexes, than in any other of those branches of knowledge which, in other respects, have raised him so far above the rest of the living world."

Mr. Preston then proceeds to plead for greater freedom in the relations between the sexes. He denounces the rigid Puritanism, absurd proprieties, and restraints of the present day, especially in England. He argues that "an unnatural system of coercive restraint aggravates the passions [why plural? would not 'appetite' be the better term?] to an inordinate degree, and is certain to be followed by excesses." This is scarcely to be doubted. Probably in no capital city does prostitution appear in a form so dangerous to society as in prudish London. "Puritanism," says our author, "may truly be said to be one of the worst vices, as it is the source of evils of the most injurious character." This is a bold assertion; but if we take a dispassionate review of the hindrance it has proved to Art, to Literature, and to Science even, and that those districts where it was most rampant are precisely those where to this day the lucrative vices most flourish, we shall not be able to refuse our assent.

But we, as a people, have been reared for generations under such a system of hard-and-fast regulations, imposed upon us not by any tyrant, but by ourselves, that their removal would be the signal for impropriety. On the Continent, *e.g.*, public gardens can exist without fences and gates. Were we to try the experiment our parks would quickly be ravaged and laid waste. Hence any relaxation of existing customs can be effected but gradually.

The second essay, "Science and Sectarian Religion, or a Personal Experience of the Evils of Religious Doctrine," bears the significant motto "Truth needs no sanctification," and is even bolder than the foregoing. A work which appeared a few years ago, under the title "The Unseen Universe," furnishes the author with his starting-point, though it is not formally reviewed. A prominent and startling idea is most distinctly conveyed in the following passage:—"According to the dogma of infinitely lasting punishment, the punishment for vice in this world would be *infinitely* inadequate, which is practically tantamount to teaching that the pursuit of vice must be infinitely profitable in this life." Mr. Preston made substantially the same statement in a paper on Natural "Science and Morality," which he communicated to the "Journal of Science" in 1880, and which will be found on p. 450. We do not find, however, that anyone has attempted its refutation.

On p. 27 we find a passage which may sadden or amuse the reader, according as he is of a Heraclitan or Democritan vein:—"I may mention here (for the sake of illustration) the modern 'Salvation Army' scheme, whose programme a well-known Review has recently lowered itself enough to publish." In a

note the author adds, "Could it be believed in any *civilized* country that a respectable journal would publish a programme like that of the 'Salvation Army'? This is an instance, I think, of the point so instructively brought forward by the late Mr. Darwin as to the peculiarities of the *flora* and *fauna* of *islands*. The *inhabitants* are of course included. Therefore this may account for the extraordinary anomalies and mixtures of the human mind that one finds in this country, great geniuses and great fools (if a too coarse expression be excused). What continental journal of the character of the Review alluded to would have published, among papers sometimes filled with the highest contributions to Science, the screamings of 'Hallelujah Bill' and of 'Salvation Sal,' as they have been aptly termed?" This is doubtless sad; but it is no less sad to see a journal which poses as the highest organ of Science—at least of official Science—in this country insert advertisements of life-pills and of "pick-me-ups"!

In a note on pp. 32, 33 we find a statement on which issue may be fairly joined. Says the author:—"But then every competent judge knows that what evidence there is points overwhelmingly *against* an eternal existence, especially the great principle of Evolution which correlates man with the rest of the living world, which are admitted *not* to have a future life, but to give up life at their decease." Mrs. Grundy doubtless makes this admission concerning the lower animals. Bishop Butler does not. For our part we cannot help feeling that the evidence for animal and for human immortality is identical. The two cases, in legal phrase, run on all fours together.

The third essay treats of the "Scientific Basis of Personal Responsibility, or the Mode of reconciling Personal Responsibility with the Principle of Strict Causation in Nature," and is a development of the author's paper in the "Journal of Science' for 1880, p. 457. Mr. Preston opens the discussion with an oft-mentioned difficulty:—"The criminal may retort 'My actions being the result of natural causes, why should I be punished for what I cannot help?'" John Stuart Mill is also quoted as saying, in like strain, "The Owenite invokes the admitted principle that it is unjust to punish anyone for what he cannot help." To us this difficulty, if any, seems to have been needlessly magnified. Not to mention that Society may reply to the criminal, "By the very same natural causes we cannot help hanging you!" there is a fallacy in the word "punishment." The first of our natural rights, that of existence, involves the right of eliminating if possible whatever attacks us, be it assassin, ruffian, tiger, wolf, cobra, disease-germ, flood, or conflagration. We do not punish the man-eating tiger; we eliminate it. We do not punish disease-germs; by drainage and disinfection we aim at their extirpation. Just in like manner with the assassin or the burglar: if the instinct of self-preservation is not dead within

us, we take care that when once recognised as such he shall not have the opportunity of repeating his offence, and especially of reproducing criminal descendants.

The author's proposal of inflicting penalties equal to the sum stolen, &c., multiplied by the chance of detection, might answer admirably for offences against property; but for crimes against the person—which our laws, with the single exception of wilful murder, punish more leniently—it would be utterly inadequate, and, like our present system of inflicting paltry fines for cases of ruffianism, would be merely adding insult to injury.

We have not the pleasure of agreeing with all the positions advanced by the author; but we must recognise this little work, as a whole, as a signal instance in favour of applying the principle of Evolution to the study of Sociology and Ethics.

Poisons: their Effects and Detection. A Manual for the Use of Analytical Chemists and Experts. With an Introductory Essay on the Growth of Modern Toxicology. By ALEXANDER WYNTER BLYTH, M.R.C.S., F.C.S., &c. London: Charles Griffin and Co.

WITHOUT doubt we have here the most comprehensive and trustworthy book on Poisons which has thus far appeared in the English language.

In an introductory chapter on the "Old Poison Lore" the author expresses the not improbable surmise that "the first poison-knowledge was that of the septic poisons. Perchance the savage found that weapons soiled with the blood of former victims made wounds fatal: from this observation the next step would be that of experiment,—the arrow or spear would be steeped in all manner of offensive pastes, and smeared with the juices of plants which were deemed noxious; and as the effects were mysterious they would be ascribed to the supernatural powers, and covered with a veil of superstition."

From this traditional origin the history of poisons and poisoning is traced downwards with the aid of such fragmentary records as exist. It is stated that Attalus Phylometer, of Pergamus, was acquainted with Hyoscyamus, Aconite, Conium, and Veratrum, and that the Egyptians were acquainted with prussic acid, at least in a dilute state, as obtained from certain plants. There is, according to Duteil, in a papyrus preserved at the Louvre, the sentence "Pronounce not the name of I. A. O., under penalty of the peach!" implying that those who revealed the mysteries were put to death with peach-water. There is

little ground for doubting that the art of distillation was practised by the Egyptian priests. Indeed their knowledge, not only of Chemistry, but of Anatomy and Pathology, was assuredly far greater than is vulgarly supposed. The records of their lore perished, however, long before the reputed burning of the Alexandrian Library of the Arabs. No small portion of the guilt of this destruction must rest upon the early Christians (*see* Acts xix., 19), especially the monks, who played the same part in Egypt which they afterwards repeated in Mexico and Peru.

Nicander, of Colophon (204—138 B. C.), is said to have written on Snake-venoms, and on the properties of Opium, Henbane, certain Fungi, Colchicum, Aconite, and Conium.

On the subject of slow poisons which do not prove fatal until a considerable time after their introduction into the human system, Mr. Blyth holds an opinion which is scouted by many modern authors, but which we believe to be something more than a legend. A few cases of this kind have come to our knowledge. The writer remarks that certain malignant diseases answer precisely to the description of a poison which has no immediate effects, or which, in technical language, has its "time of incubation." The length of time that the poison of rabies can thus remain latent is well known, and there is at least no inherent impossibility that other poisons may be equally slow in developing their effects. Mr. Blyth says that the gipsies "have long possessed a knowledge of the properties of the curious *Mucor phycomyces*. They are said to have administered the spores of this fungus in warm water. In this way they (the spores) rapidly attach themselves to the mucous membranes of the throat, all the symptoms of phthisis follow, and death takes place in from two to three weeks."

The poisoners of the East not only select an agent which may in its effects simulate some natural disease, but, if practicable, one to which the intended victim might seem naturally liable.

The legend of Statira, poisoned by means of food cut with a knife, envenomed on one side only, has in it nothing impossible.

The great schools of poisoning which flourished in Venice and in the more southern parts of Italy from the fifteenth to the seventeenth centuries are ably described. There is here matter which might be welcome to the novelists of the day in their evident exhaustion of subjects and inventive power. At Venice the Council of Ten had their secret poisoners, who, for a due consideration, were ready to take in this manner the life of any potentate whom the Republic might consider dangerous. There was a regular tariff agreed on, increasing with the eminence of the victim, the length of the journey, and the difficulties and dangers to be encountered.

The "Natural Magic" of Baptista Porta contains many curious receipts for poisoning, and in the author's opinion the general tone of this treatise proves that Porta was no mere theorist, but had studied the matter experimentally.

The deadly nostrums used by Toffana and Keli, and afterwards imparted to M. de Sainte Croix and his paramour, the infamous Madame de Brinvilliers, seem to have been not mere arsenic, but to have contained a peculiar ptomaine, which, according to Selmi, is formed when animal matter decomposes in contact with arsenical solutions. One method of preparing such a poison, not mentioned in the text, was to dose a bear with arsenic, suspend him by his hind legs, and collect the liquid which issued from his mouth and nostrils during his death-struggles, or, as others say, during putrefaction.

In what may be called the practical part of the work Mr. Blyth discusses systematically the various known poisons, expounding their chemical nature, their mode of action, the symptoms preceding death, and the appearances presented on *post mortem* examination, as well as the most approved methods of separating such poisons from the contents of the stomach, the urine, the liver, brain, matter vomited, &c. Illustrative cases are also given, and—a very important feature—the attention of the expert is called to possible lines of defence and to questions likely to be raised by the opposite side.

Space will not permit us to do more than notice the section on animal poisons. Great merit belongs here to Mr. Blyth for the part he has taken in proving that snake-poisons are not ferments, capable of reproduction and multiplication in the blood or the tissues of the victim, but true, definite, chemical compounds, or mixtures of such compounds. As a matter of course germicide agents are utterly useless as antidotes. Dr. Shortt, as well as the author, had long ago found that potassium permanganate, recently recommended by Dr. Lacerda as an antidote, is ineffectual.

Concerning cantharides an interesting fact is brought prominently under notice. These insects may be eaten with impunity by the hedgehog, by fowls, turkeys, and frogs; but a man, a cat, or a dog may be poisoned by eating the flesh of animals which have thus fed upon cantharides.

The French "military surgeons in Algeria often meet with cystitis among the soldiers, caused by eating frogs in the months of May and June, the frogs living in these months almost exclusively on a species of cantharides."

In a case of poisoning by cantharides in any country where these or kindred insects occur, this fact would suggest a line of defence not merely plausible, but possibly well-founded.

The ptomaines are treated as fully and thoroughly as the present state of knowledge admits. None of these bodies, it is conceded, has been sufficiently studied. A needful caution is given against reliance upon the potassium ferrid-cyanide test.

Bleaching, Dyeing, and Calico-Printing, with Formulæ. London: J. and A. Churchill.

We have here a treatise on the three important and kindred arts of bleaching, dyeing, and calico-printing, compressed into the very brief space of 203 pages, the index being included. Under each of its leading sections we find a sketch of the history of the art,—which might, perhaps, have been better left to be dealt with in larger works, theoretical explanations, and practical procedures. The receipts, though necessarily very few in number, are taken from modern practice, and, as far as they go, may be safely followed. A few passages are open to be misunderstood. Thus on p. 63 we read—"The perrotine is employed in the French and Belgian factories, but not in the English, and effects a great saving of time and labour over hand-block printing; what required twenty men and twenty children, by this latter method being accomplished by the perrotine by one man and two children.

This is perfectly true, and yet to an outsider it is capable of conveying the false impression that hand-block printing is still in common use in England. The fact is that the great bulk of English printed calicoes are executed by means of the cylinder machine, which effects a still greater economy. We find the author saying—"In certain cases, such as in printing woollen and mousseline de laine goods, block-work has been very generally superseded by cylinder-printing." Now it is precisely in woollen-printing that the cylinder-machine is least satisfactory, and that blocking remains to a considerable extent in use.

In a note at the foot of p. 78 it is stated that Kopp first suggested the use of hyposulphite of *soda* as a mordant. We presume that this is a clerical or typographical error for "hyposulphite of *alumina*," which was proposed by Kopp in place of the acetate of alumina. Concerning the advantages, however, most practical authorities are sceptical, and it does not seem to have come into extended use.

We do not see any reference to aluminium sulphocyanide, now so largely used for alizarine steam reds in place of red liquor. In one receipt for an extract red it is mentioned along with red liquor.

We can scarcely enter into the spirit of those portions of the following passage which we have italicised:—"The discovery and application of the coal-tar colours have given an unprecedented impetus to this among other branches of calico-printing, not only by increasing the number and variety of tinctorial agents possessing purer tints, *but because the raw material for manufacturing them lies around us.* At the present day when the printer requires pale chintzes it is not necessary for him *to*

ransack the two hemispheres for the red, yellow, blue, green, and violet dye-stuffs, as it was not many years back."

The "raw material" for manufacturing tinctorial agents undoubtedly "lies around us," but unfortunately it is not manufactured around us. It is sent abroad to be manufactured by alien capital, skill, and labour, and comes back to us at prices which play into the hands of our industrial rivals. The "ransacking the two hemispheres" was to a great extent simply importing dye-wares from the colonies to the profit of our countrymen and fellow-subjects.

The section on dye-wares contains some errors not easily accounted for. Thus Brazil wood is described as identical with camwood! The names adopted for the dye-wares and chemicals are in many instances different from those in use, in dye- and print-works, with which the technological student should make himself familiar. Typographical errors are rather numerous. In reading over the index we come, *e.g.*, upon the "ferrocyanide of *tar*"—a gruesome compound.

As a whole, however, this little work deserves commendation, and in the probable case of a second edition it may be easily freed from its defects.

On Life and its Lessons. Being the Inaugural Address delivered to the Bristol Medico-Chirurgical Society in the Session 1882-3. By JAMES GEORGE DAVEY, M.D. Bristol: Fawn and Son.

THIS Address bears the aspect of a controversial manifesto. The author sets out with the dictum of Pope, "The proper study of mankind is man," to which, for men of Science other than physicians, we must demur *in toto*. After referring to the lectures of Lawrence on Man, Dr. Davey contends that there are in our days "men of mark and taking rank as physiologists who are using their best endeavours to stamp out the materialistic views of the new school of thought, and to replace them with the metaphysical and old-fashioned theories of early and ignorant times. The controversialists insist on enveloping their studies in so dense a cloud of assumption and mysticism that truth is nowhere to be found. Their reason is beclouded with a wild imagination,—and so it is they are lost in their delusions,—and, like the many recognised as *crazed*, are really objects of our compassion and sympathy."

Among these writers the foremost place is assigned to Dr. W. B. Carpenter, who is in substance, though not in so many words, accused of being swayed by "dominant ideas"!

It appears that the learned and voluble doctor communicated to the "Modern Review," in 1880, an article with the title "On the Forces behind Nature." Whether any such forces exist must, of course, depend upon the connotation which we give to the term "Nature." But what was the head and front of the offending of his old enemies the Spiritualists, save that they admit forces other than those commonly recognised as natural? How are the mighty fallen! If there are forces (? energies), personal or impersonal, behind Nature, which we here neither affirm nor deny, they must be either regular or capricious in their action. If regular, they may and should be studied. If capricious, Science becomes impossible, and Dr. Carpenter's avocation is gone.

Dr. Winn, following on the same side, denounces Professor Tyndall,—who as a correspondent shows is no Materialist,—*ore rotundo*. He tells us that "all unverified theories must tend to subvert the fundamental principles on which our morality and polity are based." Most theories have no bearing upon our morality at all which, moreover, can alter its bases without altering its code.

Further, Dr. Winn pronounces Prof. Tyndall to be "the subject of unbelief in what is true," and devoid "of a due faith in whatever is good and profitable to humanity." Can Dr. Winn make good these charges? If not, may they not possibly "subvert" his own morality and that of his readers?

Dr. Barclay—another writer of the same school—is said to "censure J. S. Mill for teaching that all the laws of Nature are unfailing, and, furthermore, for stating that this fact must form the major-premiss in every argument on such obscure subjects as the origin of life, of generation, of development, decay, and death."

Now here we regret that we cannot absolutely agree with Dr. Davey. Our laws of Nature—so-called—are the results of induction, and our inductions are never quite complete. Hence we are not warranted in pronouncing any event impossible, though we are fully justified in applying the most severe scrutiny to whatever deviates from the sum total of authentically recorded experience. Should anyone tell us that he has discovered in New Guinea, or in the interior of Africa, a warm-blooded animal, a mammal, provided with three pairs of limbs, we should be justified in examining the narrative of the discoverer very closely, and even in suspending judgment until a specimen of the creature had been examined by some competent authority and proved to be not a monstrosity, but a normally developed being. But we should not be justified, as some persons of eminence do, in ignoring the evidence offered.

On the other hand, it seems to us that if natural phenomena are controlled by will,—or at least by any will save that of a Being *ex hypothesi* immutable,—then all Science is impossible.

The suggestions which the author throws out as to the progressive elevation of the human race are sound in principle. But are they likely to be carried into effect? Is not the constitution of modern society such that the survival of the fittest is not in any way the survival of the noblest? The industrial, commercial organisation of the present is little, if any, more laudable and satisfactory than the military organisation of the past.

The Symposium: Durban Institute Magazine. January, 1884. Durban (Natal): Davis and Sons.

It is odd that this little miscellany should open with a ghost-story,—curious enough in its way, but one which thirty years ago would have been "declined with thanks" by any editor in the civilised world.

"Snake-Gossip," by W. Y. Campbell, is an interesting paper. The author states that there are in Natal twenty species of vipers (venomous serpents?), three of which are common to Europe, one to Australia, and the rest to Asia and Africa. Three of the species he describes particularly. The puff-adder, or Ibululu of the natives, seems to be identical with the *Daboaia Russelli* of India—a dangerous species. Contrary to the sweeping dictum of Charles Waterton, this species on the approach of man does not glide away, but holds his ground, and if trodden upon, or approached within a few inches, he bites. Old withered grass and stony places are his favourite habitat. The smaller puff-adder, or Inshlangwane, *Echis carinata*, is also found among tufts of dry grass and the roots of old hedges. The night-adder (Enshlangu) is identified by the author with *Bungaris fasciatus* of Fayrer. This serpent is of nocturnal habits, in shape like a "three-square" file, and is harmless if unmolested.

The English Illustrated Magazine. London: Macmillan and Co.

Among the articles in the issue before us is one on the Post-Office, which suggests to us two of the defects which still linger in our otherwise admirable postal-system. Why should monthly and quarterly journals not enjoy the same privileges as newspapers, instead of, as at present, being charged with a postage

which in some cases may amount to 33 per cent of their selling-price? Secondly, why should post-masters be empowered to keep back copy and proofs, passing per book-post between editors authors, and printers, until the next mail?

The "Character of Dogs" is a sign of the times. What shall we say to the following eruption?—"Yet more idle, and if possible more unintelligent, has been the attitude of his express detractors: those who are very fond of dogs, 'but in their proper place'; who say 'Poo' fellow, poo' fellow,' and are themselves far poorer; who whet the knife of the vivisectionist, or heat his oven (!); who are not ashamed to admire 'the creature's instinct,' and, flying far beyond folly, have dared to resuscitate the theory of animal machines."

We are not fond of dogs in *any* place; we do not say "Poo' fellow," nor do we accept the doctrine of "instinct"—in the conventional sense of the term. Neither are we converts to the theory of automatism, which if applicable to the lower animals must be extended to man also. But what of those who do not scruple to reproduce, in passing, the exaggerations and the perversions of the anti-vivisectionist? They, we fear, are the poorest of all!

The following passage, however, is worth thinking over with care:—"It is beyond a doubt to me that, somehow or other, the dog connects together, or confounds, the uneasiness of sickness and the consciousness of guilt. To the pains of the body he often adds the tortures of the conscience, and at these times his haggard protestations form, in regard to the human death-bed, a dreadful parody or parallel." We have heard it suggested that some of the higher animals have "a dim perception of the last great change," and with Mr. Romanes (*see* "Journal of Science," 1876, p. 145) we hold that they evince some rudiments of a moral sense. But the author of the article before us has gone so far that it would be interesting to know upon what facts his opinion is founded.

"The Humming Bird's Relatives" is a clever, dashing paper, in which a small portion of scientific truth is displayed to the best advantage, much as the author once remarked concerning the colouration of the "morning glory."

Longman's Magazine. No. XVI. February, 1884. London: Longmans and Co.

THIS number contains nothing which falls within our competence.

The Asclepiad, a Book of Original Research and Observation in the Science, Art, and Literature of Medicine. Vol. I., No. 1. January, 1884. By B. W. RICHARDSON, M.D., F.R.S. London: Eade and Caulfield.

By far the greater part of this work concerns the medical practitioner only, and appeals as little to non-professional men of Science as to the lay public.

The first of the essays here placed before us gives an interesting account of the subcutaneous use of morphia, now becoming increasingly common. The author considers that "alcohol, acting like an additional worry and wearer of life, is an important secondary agent in the production of the opium *habitué*. This may be so, but we should conclude that the primary agent is the increased over-work and worry characteristic of the latter half of the century, and which is a phenomenon perfectly without precedent in the history of the human race. The author mentions the case of a medical man who, in the space of three years, had injected into himself 6000 grains, sometimes using 12 grains daily.

"Harvey after Death" is an account of the re-interment of the illustrious Harvey, which took place at Hempstead, in Essex, on the 17th of October last.

The concluding essay, "Felicity as a Sanitary Research," opens up some of the gravest questions. Dr. Richardson asks—"Can we honestly believe that these triumphs of ours which have so far ended in a certain victory over death have introduced any great triumph over misery? Have we by our labours made men, women, and children greatly happier as well as longer lived?" He adds, very truthfully, "These questions are momentous, because, if we are aiding in the act of adding to length of life and in developing population without giving to an extended and universal life Felicity, we may, in the long run, be working evil rather than good for the human race. . . . Surveying the questions I have submitted, I do not think that we have, so far, done very much to add to human felicity."

This is very nearly the same ground which we have taken from time to time. Sanitarians have been very anxious to root out smallpox and typhoid fever, cholera and diphtheria. But what have they done to counteract insanity, paralysis, diseases of the heart, and, in short, chronic debility in every form? Have they diminished or rather intensified the "struggle for existence," which more and more compels a man to employ his whole energies in the mere earning a livelihood, so that, as the "Spectator" puts it, the class, at least, which depends on brain-work is "harassed as it never was harassed before"? We fully admit that were the struggle for existence entirely abolished the

majority of men would sink down into apathy, and undergo a relapse into savagery. But there is a measure, a *via media*, in all the agencies which affect life. There are certain limits between which life is worth living, and, as far as work and competition are concerned, we have already touched, if not overstepped, the maximum.

We are extremely glad to find a sanitary reformer of such merit and influence as Dr. Richardson turning his thoughts in the direction shown in the present essay. We rejoice to hear him say—"Inasmuch as felicity is impossible under mental strain, it is fatal work to press on the young mind the excessive labour which is now in all departments making cram, cram the footing for knowledge.

We should like to see this paper, "Felicity as a Sanitary Research," circulated literally by the million.

Botanical Micro-Chemistry: an Introduction to the Study of Vegetable Histology, prepared for the Use of Students. By V. A. POULSEN. Translated with the assistance of the author, and considerably enlarged, by WILLIAM TRELEASE, Professor in the University of Wisconsin. Boston: Cassino and Co. London: Trübner and Co.

MICRO-CHEMISTRY has now become an important method of research. The student of Histology, vegetable or animal, no longer finds it sufficient to examine tissues, fluids, &c., under the microscope, even with the aid of the polariscope and spectroscope. He finds it necessary to treat his objects with certain chemical reagents, and to note the changes of texture or of colour thus produced. By this method the resources of the microscope have been, we may say, indefinitely enlarged, and the conclusions reached by its aid are rendered much more decisive.

The author of the little treatise before us confines his attention to vegetable histology, but much of what he says is applicable also in the minute study of animal matter.

The first portion of the work is devoted to an account of the reagents used, the manner of their application, and the results which they may be expected to produce. The colouring agents which have been successfully employed for the differentiation of the tissue-systems, and for the recognition of some of the cell-contents, are clearly described. We find it, however, singular that "fuchsine" and "magenta" are spoken of as two distinct colours. The former is simply the Franco-German name for the

latter. An Appendix to this section treats of media for mounting and of cements.

The second chapter describes, *seriatim*, the chief vegetable substances and the methods for their recognition. The entire work, within its very limited compass, is excellent, and will be found a safe guide to the student in vegetable physiology.

Longman's Magazine. No. XVII. March, 1884.

THE only article in this ably conducted magazine which we feel competent to notice is one entitled "Queer Fishes." It gives a popular and sketchy, but not the less essentially accurate, account of some of the strangest developments of fish life,—of venomous fish, blind fish, fish that travel on land and are even said to climb trees. The only queer fish omitted is the marksman-fish, which, so to speak, shoots flies sitting on waterside plants by projecting at them a drop of water.

Many important works stand over for want of space.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

ON CYCLING.

In reviewing Dr. Richardson you say that the cyclist moves too fast for close observation of Nature. I partly admit this; but an hour's cycling through 10 miles yields far more observation than an hour's walk through 3 miles, and you overlook the *silence* with which the cyclist approaches animals. For years I tried to see a corn crake, and never succeeded till a tricycle enabled me to surprise one by a roadside. The bicycle has enabled me to observe a weasel hunting by a hedgeside, and to get within 20 yards of it. I have heard the nightjar only during bicycle rambles, and never saw one except when I was cycling near Stratford-on-Avon. The only wild swan that I ever saw flew overhead while I was cycling at Papplewick, near Newstead. I noticed great improvement in the woodland paintings of Alfred Cox when he took to bicycling, to say nothing of improvement in his shape—from more than 16 stones to less than 14.

Let me, as President of the Nottingham Bicycle Club, join in commending cycles to all lovers of Nature.

HUGH BROWNE.

CANAL CUTTING.

In No. 155 of the "Edinburgh Review" is a very able article on schemes for cutting the Isthmus of Panama, and it treats as a great difficulty the excessive rainfall—more than 120 inches—in the district of Chagres, through which M. Lesseps projects a canal. Ought it not to be the greatest help? The Reviewer implies that all excavation must be done with the spade, but Californian miners have shown that water is far more effective; they conduct it along hill-sides at great expense, and then they direct it through the pipe of a *monitor*, with a force fatal to any man who gets in its way, and rocks and gravel break and disappear before it. With it one man does the work of fifty with

spades, and it work night and day without stop. The abundant water of the Isthmus seems the very means required for cutting it; and, unless I am mistaken, the monitor is equally capable of dredging and deepening a canal wherever there is stream to carry off the *débris* which it makes. It is possible that a hilly district, with copious water, may be easier to cut than a dry plain of sand.

HUGH BROWNE.

THE SCIENCE-TEACHERS AND THEIR POSITION.

PROFESSOR GALLOWAY, in his able articles on Technical Education, has shown by the testimony of the official examiners ("Journal of Science," 1883, pp. 542, 543) that Science-teaching in this country is unsatisfactory. But can anyone fail to see the why and the wherefore? So long as the system of payment by "results"—so called—obtains, so long the teacher can only earn his modest remuneration by training his pupils not "to know, but to pass." Most of us would prefer to give *bona fide* practical instruction, but the "Deparment" will not allow us. It was an evil day for scientific education in this country when Sir Lyon Playfair was eliminated from the Secretaryship and his place was taken by Colonel Donnelly.

SCIENCE-TEACHER.

THE SCIENCE AND ART DEPARTMENT.

THE thanks of the Science-teachers of this country are due to your contributor Mr. R. Galloway for his able and unanswerable impeachment of the Science and Art Department. In common with not a few of my colleagues I hope that the eyes of the public may be opened to the shortcomings of a system which effects little save waste of public money, and aims more at bureaucratic power than at the scientific education of the nation. It is truly sad that eminent men whose own published words condemn the Department should yet lend it their influence and the weight of their names.

CHEMICUS.

[We have received several more letters similar to the above.]

SQUIRRELS' NESTS.

I HAVE just got my copy of the "Journal of Science" for February, and I see in the Correspondence an interesting note about Squirrels.

On Friday last, February 8th, when two friends and myself were searching for traces of ice-action on the hard quartzites that form steep cliffs on the north side of the Vale of Pluscarden, in the county of Elgin, and near the ruins of the Priory, we found a squirrel's nest in a juniper bush about 4 feet high. The bush at the top is very dense, and the nest beautifully formed of the mosses that grow around, interwoven with twigs of the tall bare larches that flourish on the *talus* below, and, on the steep slope above the ledge where the juniper grows, cannot be seen unless one be looking very closely into the bush. While I was examining the nest and feeling for the entrance the squirrel darted out, leaped down 8 or 10 feet to the top of the *talus*, and mounted the nearest larch. A nest on any of the surrounding larches would have been too easily seen, and would not have been so secure and *cosy* as one in the low juniper.

JAMES LINN.

Geological Survey, Keith, Banffshire.
14th February, 1884.

NOTICES TO CERTAIN CORRESPONDENTS

Particulars concerning insects and their larvæ in the human body may be found in the "Transactions of the Entomological Society" for 1840, vol. ii., pp. 256 to 271.

Mr. Fahie's work on the discoveries of E. Davy in electro-telegraphy was noticed in our issue for October, 1883.

A paragraph on the alleged presence of hydrogen peroxide in the atmosphere of Italy, and its supposed effects on the human voice, appeared in our February number. We cannot, under any ordinary circumstances, insert matter sent us in slip which has been "going the round of the press."

NOTES.

The Colorado beetle (*Doryphora decemlineata*) has been found by J. D. Forbes ("Amer. Journ. Pharmacy") to contain a vesicating principle. Whether it is identical with cantharidine is not decided.

Dr. P. H. Clarke ("Detroit Lancet"), after studying the determination of sex in offspring, concludes that the union of the sperm and germ-cells is a complete union, molecule by molecule. Sex is a condition of external force engrafted subsequent to the union of the cells, this force depending upon nutrition and other conditions independent of sexual potence. An important source of sexual determination is nutritive.

According to Högbom (Acta Reg. Societ. Scient. Upsala) the advantage of an insular and the disadvantage of a continental climate is more marked in autumn than in spring.

Herr Keller ("Schweiz. Gesell. Naturwissenschaft"), studying the interchange of animal forms between the Red Sea and the Mediterranean by way of the Suez Canal, remarks that the mollusks form the main contingent of emigrants, worms, crustaceans, and fish hold a middle rank, whilst the echinoderms and cœlenterates are little disposed to wander. Pelagic forms are of course excluded from this way of emigration. No littoral cephalopods have been found to travel by this route.

According to Col. H. C. Tanner the Indus between Bowanji and the Darel district flows at the bottom of a ravine 17,000 feet in actual depth.

The "American Naturalist," in noticing a memoir of Dr. H. A. Hagen, considers that the North American species of *Colias* may be reduced to three,—*Eurydice*, *Cæsonia*, and *Chrysotheme*, —with perhaps thirty local and seasonal varieties.

A certain Prof. Johnson, residing at Ontario, maintains that "the interior of the earth is a vast mass of electricity in one portion, and a great sea of fire in another. Before fifty years these two will come together, and there will be an awful collision."

A Japanese, Isac Tijima, has received the gold medal offered by the University of Leipsic for the best original work on the embryology of fresh-water planarians.

According to S. L. Ricciardi plants growing on the lava-soils of Etna contain appreciable quantities of vanadium.

"Les Mondes" recommends the leaves of rhubarb to be eaten in spring along with sorrel,—oxalic acid seasoned with oxalic acid.

According to the "Indiana Pharmacist" Dr. R. R. Gregg, of Buffalo, asserts that all the bacteria of disease are merely forms of fibrine.

According to Dr. Sutton ("Lancet") the majority of the monkeys in the Zoological Gardens die of bronchitis or of pneumonia. Only about 4 per cent of the deaths are due to phthisis.

At the January meeting of the Geological Society Mr. Blanford raised the question whether the Red Sea was older or newer than the Desert sandstone? Mr. Doughty mentioned that volcanoes had been active near Medina as late as the twelfth century.

M. Ballo (Ungar. Akad. der Wissenschaft) contends that one function of the roots of plants is to convert inorganic nutriment into the simpler organic compounds by a process of reduction. Chlorophyll may be regarded as a thermo-electric battery which converts the heat and light-rays into a galvanic current, and ultimately into chemical work.

According to a writer in "Light" the "Mahdi in the Soudan is no false prophet, but a pure medium, and the movement he leads will be the means of bringing about a universal church and brotherhood."

Dr. Wyld, in the same paper, writes:—"The rotatory force of our planet may be maintained, I would suggest, by the sun's rays striking her at a tangent due, perhaps, in part to the planet being eight minutes in advance of the propulsive rays of the sun.

On February 5th Mr. R. F. Conder read a most important paper, on "Speed on Canals," before the Institution of Civil Engineers. He explained the defects in the construction of the Suez Canal, and showed that by a scientific construction and the application of steam-power a normal speed of 5 miles per hour (equal to the through average rate of mineral trains) might be maintained on our inland water-ways.

According to O. E. Randall ("Popular Science Monthly") the birth-rate in New England families has steadily decreased since the extensive establishment of manufactures.

Prof. Struve, in a conversation with Prof. Piazzi Smyth, is said to have maintained that "the first boys at school disappear in the colleges, and those who are first in the colleges disappear in the world."

The upholders of the vested rights of syphilis have held a great demonstration in Exeter Hall.

Dr. F. Hulwa ("Gesundheits-Ingenieur") proves that the water of the Oder, after receiving the sewage of Breslau, is purified by the oxygen of the atmosphere and the action of vegetation. Fourteen kilometres below Breslau the sewage matters can neither be detected chemically nor microscopically, and the water was of the same quality as above the town.

Dr. E. von Raumer shows that the special function of lime in vegetation is the elaboration of material for increasing and strengthening the cell-walls. Magnesia, on the other hand, mediates the transportation of starch, and subserves the formation of chlorophyll.

Mr. J. Gunn, F.G.S. ("Geological Magazine") contends that the levelling of mountain ranges may be the cause of warmth of climate, just as their elevation is productive of cold.

Certain experiments made by Prof. Bunge ("Zeitschrift Phys-Chemie") upon Entozoa tend to show that the sources of muscular power in animals do not exclusively reside in the process of oxidation, but in the decompositions which take place in their food. Hence the less body-heat is required, the less is the need for oxygen.

Respecting the resolution of diatom markings Professor Abbe writes:—"All speculations as to the true structure of even *Pleurosigma angulatum*, so far as they depend on microscopic vision, are mere phantoms, castles in the air. No human eye has ever seen, or ever will see, the complete diffraction-spectra arising from a structure of this minuteness, nor will any microscope ever show an enlarged copy of it, so long as the spectra cannot be observed in a medium of at least 5·0 refractive index and by an objective of 5·0 numerical aperture,* which, as far as our present knowledge goes, is an impossibility. The microscopes of the present day admit relatively a small central portion of the whole diffraction-spectrum of the valve,—*i.e.*, the incident beam and the six spectra of the inner circle. But this portion is also yielded by a multitude of other objects which are endowed with an alternation of superficial or internal molecular structures which cross each other in two differeat directions at an angle of 60°. Such structures may be formed in various widely different ways; it may be by rows of spherules or other prominences of any shape whatever; rows of internal vacuoles of any figure, or the mere internal alternations of molecular aggregations within a perfectly transparent and smooth silica film. And yet all these yield with central light the identical circular field of the *angulatum* valve, even to the most minute particular. But although these spectra are identical as far as the six inner spectral beams are

* Half the sine of the angle of aperture multiplied by the index of refraction of the medium in which the object is viewed.

concerned, they may be vastly different in regard to some or all of the more widely diffracted pencils which are not admitted by the objective."

Of the ordinary members of the French Academy of Sciences two only have not received the "Legion of Honour."

Sir Joseph Fayrer considers the idea of finding a physiological antidote for snake-poison a Utopia. He maintains that venomous properties are communicated to the blood of the animal bitten, and that these properties are reproduced through a series of three successive animals. He doubts the alleged innocuity of the poison when introduced into the stomach.

According to M. Levallois solutions of cellulose in Schweitzer's reagent deflect the plane of polarisation to the left.

M. Wosnessenski ("Comptes Rendus") finds that the bacillus of anthrax developes well at 35° C., under the pressure of 3, 5, 6, 10, and 13 atmospheres. At higher pressures their development is arrested.

An attempt was made by the Bestiarians of Oxford to reverse the vote of £10,000 for erecting and furnishing a physiological laboratory. The most disgraceful means, "not stopping short at direct falsehood,"—as the "Medical Press and Circular" informs us,—were resorted to. But in the end Science triumphed by a decided majority.

According to M. Grimaux ("Comptes Rendus") mineral colloids approximate closely to the nitrogenous colloids of the organism; the retardation of the coagulation of ferric hydrate by a reduction of temperature is observed equally in the spontaneous coagulation of blood.

Snow which fell near Stockholm in December last was, according to M. Nordenskiold ("Comptes Rendus"), mixed with a black dust, consisting of carbon, iron, silica, phosphorus, cobalt, and nickel.

M. Haas ("Comptes Rendus") records that in Venezuela, September 2nd last, the sun at rising in a cloudless sky was of a beautiful blue. At noon its light was still bluish. At setting there were around its disc numerous horizontal rays of a deep blue on a pale blue ground. After the sun had entirely disappeared there was a fiery red glow in the sky which lasted until nearly 8 p.m.

Prof. F. Hoppe-Seyler ("Zeitschr. Physiolog. Chemie") pronounces the assumption of *Schizomycetes*, which can live only in the absence of oxygen, highly improbable, and certainly not demonstrated.

We are happy to find that the German Minister of Public Instruction has given his opinion against any restrictions on physiological experimentation.

Dr. Moffatt's theory of the influence of hydrogen peroxide in the air, and due in Italy as giving beauty to the voice, has been strongly combatted by Mr. Lennox Browne, who denies that hydrogen peroxide is more abundant in the air of Italy than of other countries.

Mr. Justice Stephen has formally ruled that the cremation of a dead body is not an offence at law, and can become so only if performed in such a manner as to become a public nuisance.

Mr. "Stuart Cumberland's" experimental performances at Edinburgh and Glasgow are being not unfavourably noticed in medical papers.

We regret to announce the death of the distinguished electrician Count Theodore du Moncel, editor of "La Lumière Electrique."

We are glad to find that Irish papers, of the most opposite shades of opinion, are noticing with approval the articles of our esteemed friend and contributor Prof. R. Galloway, on "Technical Education." We believe that if Science, in these realms, is ever freed from the yoke of bureaucracy, to Ireland will belong the greater share of the honour.

Prof. Jos. Rumpf (Acad. of Sciences, Vienna) has discovered a crystalline felspar—andesite—in lignite.

A meeting, presided over by Lord Stanley, of Alderley, at Bradford, adopted a resolution protesting against the system of payment by results in elementary schools, and urging that home lessons should not be compulsory on children under 10 years of age.

According to the "Electrical Review" even Philip Reis was not the first inventor of the telephone, having been anticipated by Antonia Mencci (1849) and Charles Bourseul (1857).

According to Dr. Gruber ("Zeitschrift für Biologie") all the nitrogen taken into the animal system is eliminated in the urine and the dung. There is no escape of gaseous nitrogen.

The observations of Mr. M. W. Harrington ("American Journal of Science") show that Vesta is in all probability a body like the moon, devoid of water and of a perceptible atmosphere.